

EQC

**Environmental
Quality Commission
Environmental
Indicators Program**
*Reporting on Environ-
mental Trends and Con-
ditions in Kentucky.*

1996-97 Trends Reports

- Safe Drinking Water
- Air Quality
- Waste Management
- Toxics
- Water Quality
- Natural Resources
- Resource Extraction

EQC is a seven-member citizen commission created under state law with a mission to monitor environmental trends and conditions, promote partnerships to improve and protect the environment, provide a public forum for the discussion of environmental issues, and advise state officials on environmental matters.

EQC Commissioners
Aloma Dew, Owensboro
Bob Riddle, Midway
Patty Wallace, Louisa
Harold Benson, Frankfort
Betsy Bennett, Lexington
C.V. Bennett, III, Harlan
Gary Revlett, Shelbyville

EQC Staff
Leslie Cole, Ex. Director
Scott Richards, Asst. Dir.
Erik Siegel, Research Asst.
Frances Kirchhoff, Adm. Asst.

1996-97 State of Kentucky's Environment

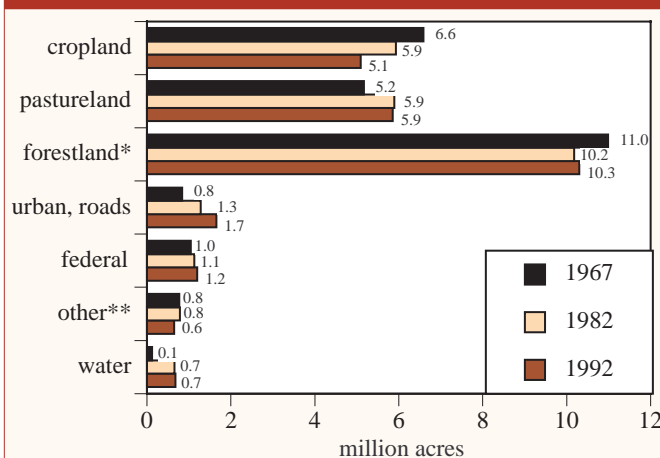
Natural Resources

Kentucky's landscape and biological diversity have undergone significant changes during the past two centuries. Vast forests and free flowing rivers once provided habitat to large herds of buffalo and elk, great numbers of black bear, and thousands of species of native plants and animals. Since settlement began, more than 200 years ago, the state's 13 major rivers have been impounded and millions of acres of forests cleared to make way for farms, coal mines, highways, and small and large urban areas. Kentucky's natural landscape has been greatly altered affecting the biological diversity of our natural communities, and in some cases, resulting in the loss of species and entire ecosystems.¹

Land Use: Cropland Declines by 1.5 Million Acres; 101 Acres a Day Converted to Urban Areas and Roads

Kentucky's 25.8 million acres of land are now primarily comprised of forest,

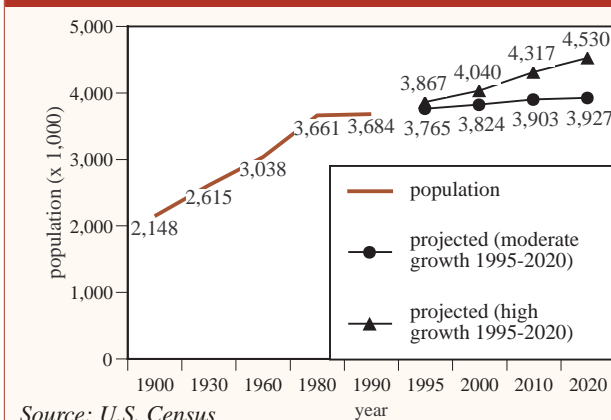
Figure 1 Land Use Patterns in Kentucky



*Non-federal lands with the exception of Land Between the Lakes.

**Farmsteads and other land in farms (ie. greenhouses, nurseries, poultry facilities; barrenland (ie. strip mines, quarries); and marshland. Source: U.S. Natural Resources Conservation Service

Figure 2 Kentucky Population Trends



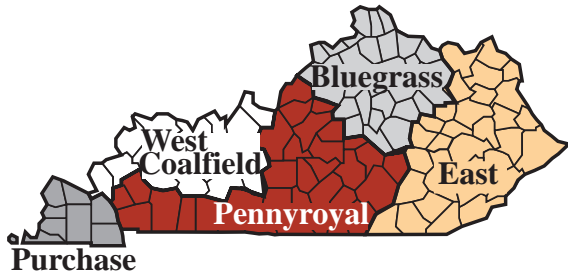
Source: U.S. Census

crop, and pasture lands with the remainder covered by roads, urban areas, water, and federal lands (**Figure 1**).² Land use shifts seen during the past two centuries are largely a reflection of a growing population (**Figure 2**) and a changing economy. For example, during the past 25 years cropland declined by 1.5 million acres. Cropland loss is attributed to urban buildup, conversion to water areas, and an increase in crop production costs resulting in the conversion of marginal cropland to pasture.³ In addition, 28% of these croplands (423,000 acres) were retired from use under the federal Conservation Reserve Program.

Land use changes are occurring more rapidly in some regions of the state than others.

Figure 3 KY's Changing Landscape

Region	1982 acres	1992 acres	1982-92 % change
East			
cropland	347,700	230,200	-34%
pastureland	729,100	1,028,100	+41%
forestland*	5,371,100	5,109,900	-5%
other**	1,410,300	1,490,000	+5%
Bluegrass			
cropland	1,364,200	1,190,400	-13%
pastureland	2,485,800	2,268,100	-9%
forestland*	1,109,500	1,328,100	+20%
other**	682,000	854,900	+25%
Pennyroyal			
cropland	1,890,200	1,702,800	-10%
pastureland	1,700,700	1,681,100	-1%
forestland*	1,908,300	1,943,000	+2%
other**	914,400	1,086,700	+19%
West Coalfield			
cropland	1,570,700	1,382,100	-12%
pastureland	783,500	707,200	-10%
forestland*	1,455,200	1,580,100	+8%
other**	663,900	803,900	+21%
Purchase			
cropland	762,000	586,400	-23%
pastureland	192,800	174,400	-9%
forestland*	336,700	351,000	+4%
other**	183,900	363,600	+98%



*Non-federal forestland with the exception of Land Between the Lakes. **Urban, roads, water, federal, and miscellaneous land. Source: National Resources Inventory, U.S. Natural Resources Conservation Service

Private and public forestlands cover an estimated 45% to 48% of the state's land base.⁶ The state's forests are largely privately owned, with about 92% in private hands.

For example, in east Kentucky, cropland declined by a third between 1982-1992, while urban and other areas nearly doubled in the Purchase region (**Figure 3**). In some cases, various uses of the land are lost permanently such as when it is converted to urban areas. The U.S. Natural Resources Conservation Service estimates that an average of 101 acres a day are converted to urban areas and roads in Kentucky. The loss of some lands, such as prime farmlands—those lands that produce the best food, feed, and fiber—have raised concern. Between 1982-1992, Kentucky lost 170,000 acres or 3% of its prime farmland to other uses.⁴ State efforts to preserve prime farmland continue as do measures to prevent soil erosion from croplands. Cropland erosion rates have declined 31%, from 10.6 tons/acre/year in 1982 to 7.3 tons/acre/year in 1992.⁵ The reduction is attributed to the increasing use of conservation tillage—various plowing methods that disturb less soil. Currently, 68% of the state's active cropland is in conservation tillage. Land use changes and issues continue to generate much debate. Controversies created by the siting of poultry and commercial hog farms in Western Kentucky, urban sprawl in Central and Northern Kentucky, and increased logging in Eastern Kentucky are among some of the most hotly contested issues of the day. This *State of Kentucky's Environment Report* will review how these and other issues have affected the state's natural resources—specifically our forests, wildlife resources, and biological diversity.

Forest Resources

Private and public forestlands cover an estimated 45% to 48% of the state's land base.⁶ These resources form the state's biological and economic base from which we derive jobs, raw materials, environmental quality, cultural heritage, recreational opportunities, and wildlife habitat.

The key to sustaining forest uses and meeting the demands of future generations is the maintenance and enhancement of our forest ecosystems. But little is known about the current state of our forests. The most recent data on the timber resource are ten years old.⁷ This is a particular concern due to growing demand for wood products. The U.S. Forest Service predicts that demand for hardwoods will increase 25%, plywood 50%, and paper/paper products 100% by the year 2004.⁸ As such, Kentucky's forests are coming under increased harvesting pressure. While data are not available to determine the current extent of logging, regeneration of harvested areas, or the overall health and diversity of our forests, the following information does provide a general picture of trends and issues affecting Kentucky's forest resources.

Forestland Loss Ranked a High Risk to Biological Diversity

Kentucky is considered the geographic center of the deciduous forests of eastern North America.⁹ The state's forests are largely privately owned, with about 92% in private hands. According to the U.S. Natural Resources Conservation Service, forestland declined by 6% in a 25-year time period, from 10.9 million acres in

Figure 4 Ecological and Environmental Risks in KY

Factor	Risk Ranking
forestland conversion	high
wildfires (impact to timber)	medium
woodland grazing (impact to timber)	medium
logging (impact to land)	medium
logging (siltation of surface water)	medium
logging (habitat loss, fragmentation, water flow alteration)	medium

Source: KY Outlook 2000, Executive Summary, May 1997

1967 to 10.3 million acres in 1992 (**Figure 1**). However, since 1982, forestland increased by 131,300 acres, from 10.180 million acres in 1982 to 10.312 million acres in 1992. During this time period forestland increased in all regions of the state with the exception of east Kentucky which saw a decline of 261,200 acres (**Figure 3**). The U.S. Forest Service, reports a greater increase in privately owned forestland, from 10.3 million acres in 1978 to 11.4 million acres in 1994.¹⁰ A state project to rank environmental and ecological risks identified the conversion of forestland to other uses as a high ecological risk in Kentucky (**Figure 4**).

Lumber Production: 1995 Near Record High

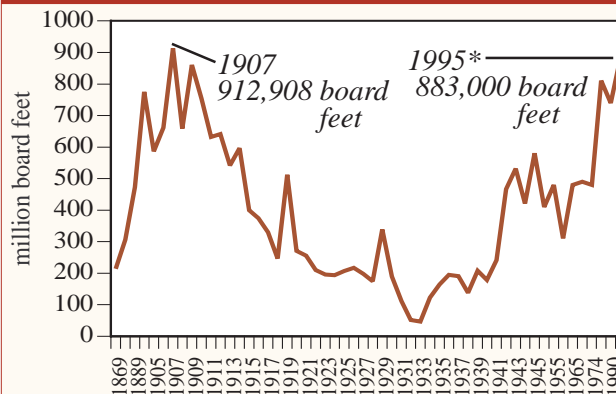
Poor logging practices such as those that cause excessive erosion, reduce critical habitat, and remove high quality trees leaving undesirable or damaged trees allowing little room for new growth, have been ranked a medium risk to the state's environmental and ecological health (**Figure 4**). The most extensive logging of Kentucky's forests began in the 1870s, and reached its peak in the early 1900s (**Logging in Jackson County**).

Kentucky's forests have had much of this century to recover and timber companies are once again expressing an interest in this resource. In 1987, the most recent year data are available, 58% of timber in Kentucky was sawtimber (9 inches (softwood) 11 inches (hardwood) or larger in diameter with at least one 12-foot sawlog).¹¹

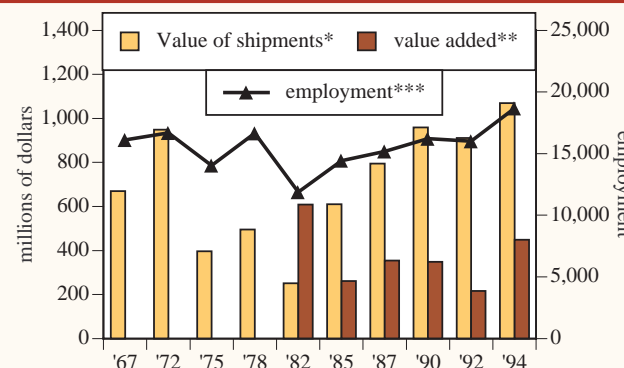
Experts agree that private forests in Kentucky are being cut at increasing rates due to timber availability and worldwide demand. One indicator of this is lumber production. Lumber production in Kentucky was near record levels in 1995 (**Figure 5**). And lumber and wood industry sales (value of shipments) are on the rise, tripling between 1982 and 1994 (**Figure 6**).¹²

Logging in Jackson County, Kentucky (early 1900s)

Source: U.S. Natural Resources Conservation Service

Figure 5 Lumber Production in Kentucky

*Preliminary. Source: U.S. Forest Service; KY Div. of Forestry

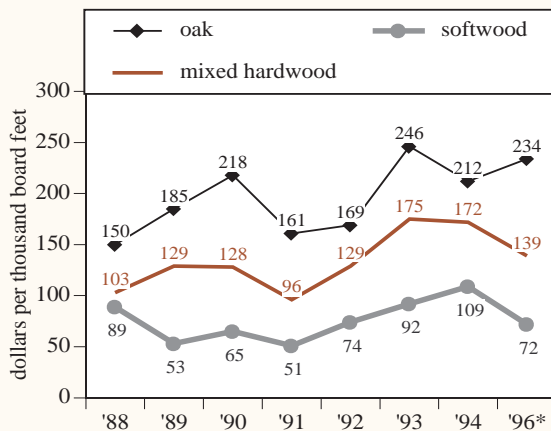
Figure 6 Kentucky Lumber and Wood Industry Employment, Value Added, and Value of Shipments

Note: Adjusted for inflation using the consumer price index for 1994. *Lumber and wood product annual sales (SIC 24).

**Lumber and wood products (SIC 24) value of product resulting from the manufacturing process (data prior to 1982 calculated differently so trend comparison cannot be shown).

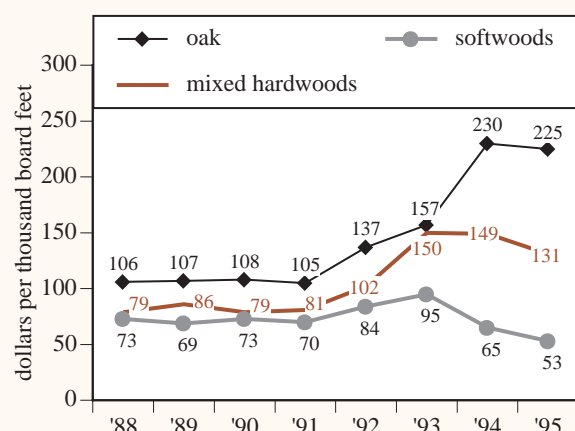
***Employment in lumber and furniture industry. Source: KY Deskbooks on Economic Statistics; KY Division of Employment

Figure 7 Timber Stumpage Prices - Private Woodlands in Kentucky



Note: 1995 data not available. Chart adjusted for inflation using the consumer price index for 1995. *1996 prices based on average stumpage prices in Tennessee. Kentucky data not available for 1996. Source: Timber Mart-South, Stumpage Price Mart; University of Kentucky, Department of Forestry

Figure 8 Timber Stumpage Prices - Daniel Boone National Forest



Note: Adjusted for inflation using the consumer price index for 1995. Source: U.S. Forest Service

Timber Demand: Stumpage Prices Continue to Increase for Premium Quality Sawlogs

Another indicator of growing demand for wood products is the price paid for timber. Demand continues to drive up stumpage prices for quality oak and walnut sawlogs (Figure 7, 8, 9).

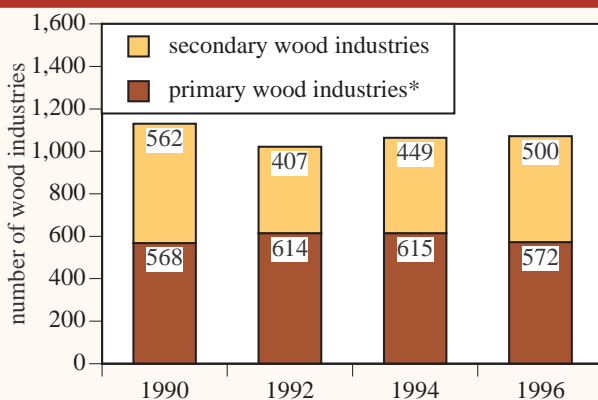
However, Figure 7 and 8 also show that stumpage prices for mixed hardwoods and pine are showing declining trends in Kentucky after peaking in 1993 and 1994. The decline may indicate a greater volume of lower quality hardwoods being harvested and used by the forest industry, according to Matthew Pelkki, a forestry professor at the University of Kentucky.¹³ He notes that with many new wood industries using small, low quality hardwoods for paper and composite wood products, the overall average price for timber is less. Because 65% of Kentucky's sawtimber is considered low quality (grade 3 and 4), the current timber markets offer landowners additional opportunities to sell timber which will likely result in a continued increase in logging in the state.¹⁴

Figure 9 Average Stumpage Prices- Daniel Boone National Forest Timber Sales (1995)

Species	Stumpage price (1,000 board ft.)
northern red & black oak	\$248.77
black walnut	\$244.30
white oak	\$179.74
yellow poplar	\$78.84
other hardwood (>grade 3)	\$54.58
yellow pine	\$39.25
other hardwood (<grade 3)	\$33.32

Source: U.S. Forest Service

Figure 10 Wood Industries in Kentucky



Note: Primary wood industries such as sawmills and paper mills process logs into materials. Secondary wood industries manufacture a product from wood materials such as furniture. *Includes pallet manufacturers. Source: KY Division of Forestry, KY Wood Products Competitiveness Council

Forest Industry: Kentucky Secondary Wood Industry Grows 11% in Two Years, Accounts for Only 1% of Nation's Employment

The state's forest industry is composed of primary producers, such as sawmills, and secondary manufacturers which make a product, such as furniture, from wood materials. The primary wood industry has declined 9% between 1994 and 1996 (Figure 10). In 1996, 572 primary wood companies were operating in the state. The decline is attributed to depressed hardwood lumber markets and wet weather making it difficult to get logs to mills, according to state forestry officials.

The state has also seen limited growth in the past of the secondary wood industry, which generally provides more and better paying jobs than the primary producers (Figure 10). While Kentucky is the 4th leading hard-

wood producing state in the country, it accounts for only 1% of the nation's secondary wood industry employment (**Figure 11**). Recognizing the potential of the secondary wood industry to add jobs and diversify local economies, in 1994 the Legislature created the Kentucky Wood Products Competitiveness Corporation. The corporation was established to enhance the secondary wood products industry and promote "Kentucky made" wood products. Since then, 51 new secondary wood industries have located in Kentucky; an 11% increase in a two-year time period.

A 1996 report by the Roundtable on the Economy and the Environment, a state advisory group to the Economic Development Partnership Board, identified several opportunities to further promote the secondary wood industry including:

- Create a program within the Economic Development Cabinet to identify prospective and expand existing secondary wood operations.
- Provide incentives to secondary wood manufacturers and promote the use of wood products generated in Kentucky.
- Prioritize state financial incentives to manufacturers that demonstrate support for sustainable forest practices.¹⁵

Figure 11 Employment in the Secondary Wood Industry (Selective States)

State	1980	1994	%*
WV	2,131	3,213	0.4
KY	8,290	9,792	1.2
GA	18,244	20,107	2.5
VA	37,056	32,947	4.1
TN	37,113	34,426	4.3
NC	102,067	111,715	14.0
US	820,236	801,274	

*Percent of U.S. employment in secondary wood industry.

Source: U.S. Bureau of Labor Statistics; KY Economic Development Cabinet

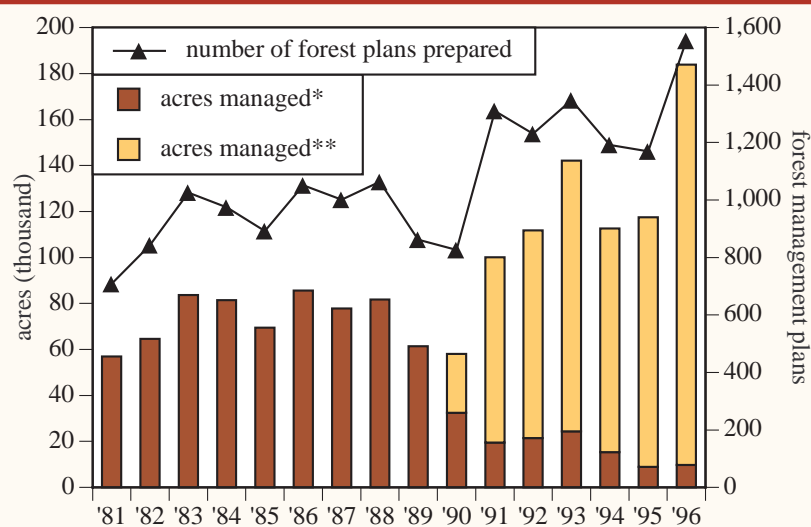
Private Forestlands: 13% Have Management Plans

Many experts agree that managing Kentucky's forests in a sustainable manner and building a diverse forest industry will require a strong program of landowner assistance and education. Government programs to assist forest landowners have been ongoing for many years. But with more than 306,900 forest landowners in the state, assistance has been limited.¹⁶ Currently, the state employs 45 field foresters—that amounts to 6,820 landowners for every state forester.

Between 1981 and 1996, the Division of Forestry worked with landowners to prepare 17,048 stewardship plans covering 1.48 million acres of forestland (**Figure 12**). This represents 13% of the 11.4 million acres of private forestland in Kentucky (as estimated by the U.S. Forest Service). At this rate, it would take 100 years to service all forest landowners in the state.

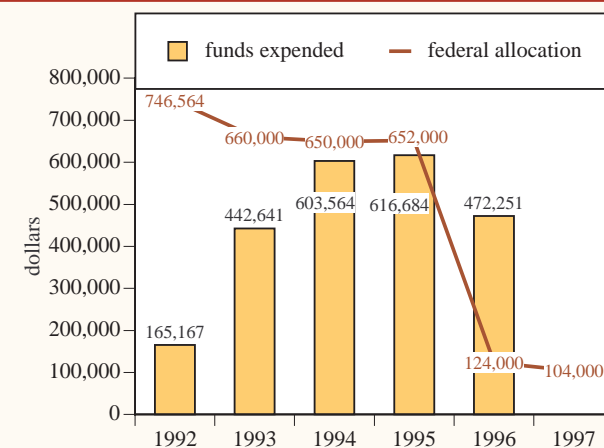
A statewide effort, however, is underway by the Kentucky Division of Forestry to contact every forestland owner in the state by the year 2000. The intent is to build awareness about state forestry programs and educate landowners about forest management opportunities. However, reductions in federal funding for the Forest Stewardship Incentives Program, which helps to finance up to 50% of the landowners costs to manage their forests, will greatly curtail the state's ability to promote sustainable forest management on private forestlands in Kentucky (**Figure 13**).

Figure 12 Forest Management Plans on Private Woodlands



*Acres with forest management plans. **Acres with plans prepared under the forest stewardship incentives program established in 1990. Source: KY Div. of Forestry

Figure 13 Funding of Federal Forest Stewardship Incentives Program in Kentucky



Source: KY Division of Forestry

Goals of Sustainable Forestry

- **View forests as ecosystems** to consider all forest life—the forest environment and the complex interaction and processes of forests.
- **Sustain productivity** of the forest to ensure re-growth and productivity.
- **Provide watershed protection** to sustain water flow and quality.
- **Maintain and protect biodiversity** utilizing scientific data, forestry assistance programs, public education, industry training, technology, and forest industry development in a manner to enhance the natural diversity of the forest.
- **Develop a sense of community regarding the forest** that recognizes the important role these resources play in our lives and the need to consider the long-term health of the forest.

Source: William Martin, Commissioner, KY Department of Natural Resources

Proposed Legislation to Promote Sustainable Forestry on Private Lands

Managing Kentucky's forests for present and future generations will require sustainable forestry practices similar to those listed in the shaded box entitled **Goals of Sustainable Forestry**. Sustainable forestry is defined as "the management and utilization of forests to meet the needs of the present without compromising the ability of future generations to meet their own needs."¹⁷

Statewide efforts to promote sustainable forestry began in 1994 when Governor Brereton Jones convened a statewide summit to assess forest policy and information needs. In 1997, Governor Paul Patton directed the Kentucky Natural Resources and Environmental Protection Cabinet to work with a diverse group of citizens, industry, and environmentalists to develop state legislation to promote sustainable forestry programs and practices on private forestlands.

The Kentucky Forest Stewardship Act was drafted in March 1997 and includes the timely collection of information about the health of Kentucky's forests, land-owner education and incentives, notification of harvesting operations, and a mechanism to designate "bad actors" who do not follow practices to prevent water pollution and other damage caused by logging operations. A final draft of the legislation is expected in late summer and is expected to be filed in the 1998 legislative session.

The estimated start-up cost for the program is \$4 million with an annual cost of \$2 million thereafter. Half of the start-up costs will fund a revolving cost-share program to assist landowners manage their forests. Another \$1 million is for a forest inventory. A funding mechanism to finance the act has not been determined but options under consideration include allocation of a portion of the state property taxes or establishing a state severance tax on timber.

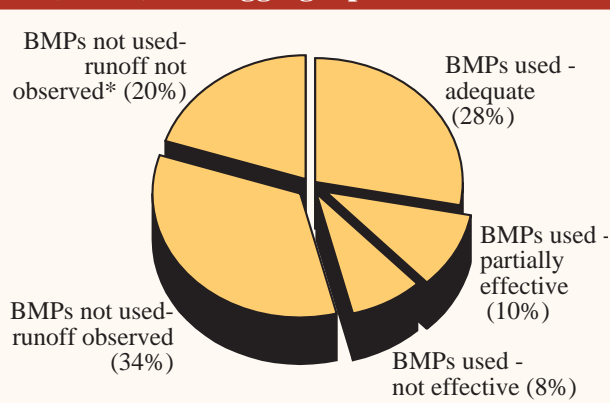
Logging Practices: 52% of Logging Operations Not Adequately Controlling Runoff Pollution

The proposed Forest Stewardship Act includes measures to address poor logging practices. Logging impacts to land and water have been ranked a medium environmental risk in Kentucky (**Figure 4**). Soil erosion can degrade water quality and aquatic habitat. According to the U.S. Natural Resources Conservation Service's 1992 National Resource Inventory, four million acres of forestland in Kentucky are in need of conservation treatment to prevent soil erosion and enhance productivity.

A 1996-97 study, funded by the Division of Water and conducted by the University of Kentucky, Department of Forestry, found that of the 100 logging operations randomly sampled across the state on private and public lands, 34% did not use Best Management Practices (BMPs) to control erosion (**Figure 14**). The study also revealed that of the 46% logging operations using BMPs, 18% of those operations either failed or were only partially effective in addressing runoff pollution.

But damage caused by timber harvesting can be easily prevented with better logger training and education. The act includes a provision that requires harvesting operations have at least one logger on site who has completed the Kentucky master logger program. The Kentucky master logger program was established in 1992 by the University of Kentucky and the Kentucky Forest Industry Association to train loggers about practices to prevent erosion, proper harvesting practices, safety, and other issues (**Figure 15**). Since then, 917 loggers have gradu-

Figure 14 Use of Best Management Practices (BMPs) on Logging Operations in KY



Note: Preliminary analysis based on random sampling of 100 active harvesting operations (90% on private land) across the state in 1996-97. *Operations were either distant from waterways or set up in a manner that avoided runoff.
Source: University of Kentucky, Department of Forestry

ated from the voluntary program. This represents 30% of the 2,993 loggers operating in Kentucky.¹⁸

Public Forests: 8% of Forestland Publicly Owned, Contributes Greatly to Tourism, Ecological Diversity

Publicly owned forests represent an estimated 923,000 acres or 8% of the state's forestland, according to the most recent U.S. Forest Service survey of 1987. State lands include 15 resort, 20 recreational, and nine historic state parks; four state forests; 35 state nature preserves; 33 state wildlife management areas, and thousands of acres of forestland owned by colleges, universities, and local governments. In addition, the federal government owns four national park, historic, and recreation areas composed of 106,390 acres; 17 Army Corp of Engineer properties containing 176,671 acres which are leased to the Department of Fish and Wildlife Resources as wildlife areas; and the 690,987 acre Daniel Boone National Forest.

Not only do these lands help to conserve the state's natural and cultural heritage, they contribute significantly to the state's billion dollar tourism industry. Tourism is the state's third largest industry in spending and its second largest employer.¹⁹ Tourism spending in Kentucky increased from \$1.9 billion in 1980 to \$7.2 billion in 1997.²⁰ In 1996 alone, total spending at state parks exceeded \$46 million.

Daniel Boone National Forest: Timber Harvests Drop 76%

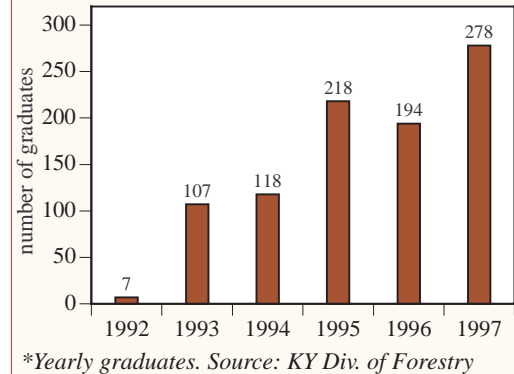
Kentucky's only national forest, the Daniel Boone National Forest (DBNF) covers 690,987 acres in 21 eastern Kentucky counties (Figure 16). These lands were set aside under federal law in the 1930s for conservation and multiple uses including recreation, water, timber, wildlife, and timber. With its 500 miles of trails, lakes, and wilderness areas, DBNF is one of the most heavily used national forests in the South, with over five million visitors annually.

The DBNF is managed by the U.S. Forest Service. Among some of the current activities on the DBNF are:

- Stream Inventory and Monitoring Program - a stream inventory and monitoring program has been developed to restore and manage 1,200 miles of waterways.
- Wildlife Management - Numerous kinds of wildlife are found on the DBNF including 32 rare, threatened, and endangered species. The U.S. Forest Service enhances wildlife through wildlife openings, prescribed burning, timber harvesting, and reduction of human impact in sensitive areas such as caves and clifflines.
- Land Acquisition - The Forest Service continues to work to acquire rare species habitat and inholdings to consolidate ownership for more effective management.
- Ecosystem Management - Efforts are underway to conduct an assessment of old-growth forest communities, rare species inventories, ecological classifications, restoration of biodiversity, and forest health assessments to manage entire ecosystems.
- Timber Management - The Multiple-Use-Sustained Act of 1960 named timber as a product that should be managed by national forests. Timber harvests have occurred on the DBNF since 1936 (Figure 17). Timber sales reached an all time high in 1989 at 45.1 million board feet, but dropped 76% in 1995 when 10.6 million board feet of timber was harvested from the forest. During the past ten years, 42,859 acres of the DBNF were logged; 6% of the forest's total acreage (Figure 18).

The decline in timber sales in the DBNF is attributed to a change in emphasis to recreation and ecosystem management as well as lawsuits and appeals challenging timber sales. One particular lawsuit has significantly impacted timber operations on the forest. Heartwood, a national group opposed to logging on national forests,

Figure 15 Master Loggers in KY*



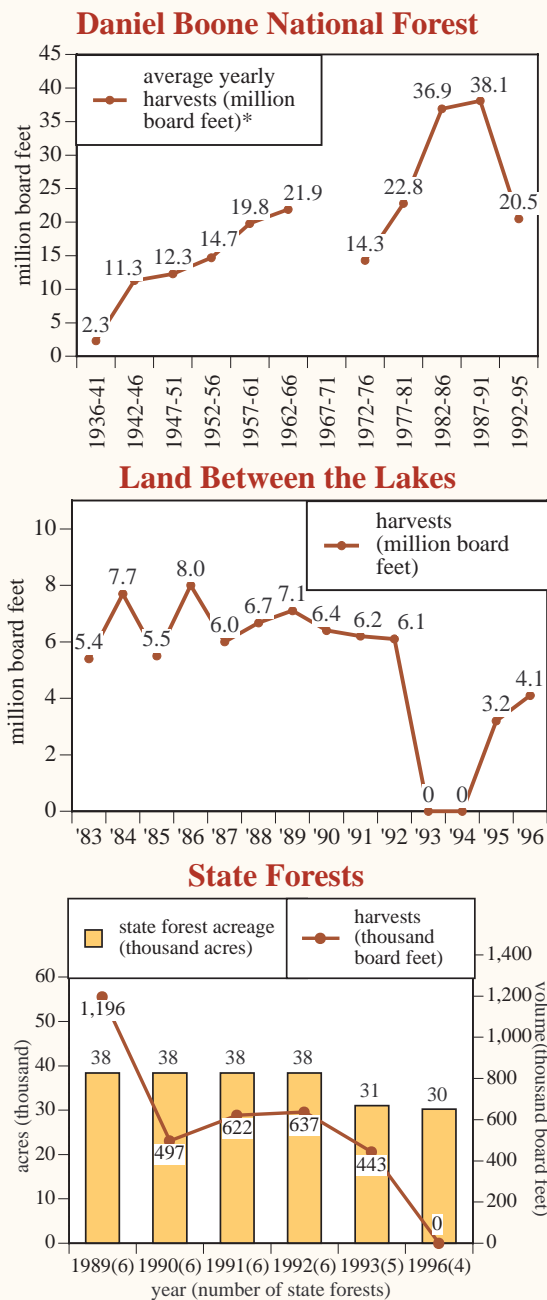
Damage caused by timber harvesting can be easily prevented with better logger training. Since 1992, 917 loggers have graduated from the Kentucky master logger program—about 30% of the loggers operating in Kentucky.¹⁸

Figure 16 Daniel Boone National Forest Acreage

County	Acreage (% of county's total acres)
Bath	19,301 (13%)
Clay	77,010 (26%)
Estill	5,598 (3%)
Harlan	803 (0.2%)
Jackson	58,375 (26%)
Knox	74 (0.02%)
Laurel	62,024 (22%)
Lee	8,587 (6%)
Leslie	52,172 (20%)
McCreary	140,877 (52%)
Menifee	46,109 (35%)
Morgan	12,948 (5%)
Owsley	16,153 (13%)
Perry	2,190 (1%)
Powell	14,723 (13%)
Pulaski	36,789 (9%)
Rockcastle	14,723 (7%)
Rowan	62,495 (35%)
Wayne	642 (0.2%)
Whitley	43,702 (15%)
Wolfe	16,167 (11%)
Total	690,987

Source: US Forest Service

Figure 17 Timber Harvesting Trends on Public Forests in Kentucky



*Based on four-year averages. 1936-61 actual harvest volumes. 1976-1995 volume sold under contract. Data not available for 1967-71. Source: US Forest Service; TN Valley Authority; KY Div. of Forestry

challenged an 199-acre sale in the Leatherwood Creek area. A federal judge ruled in May 1997 that the sale violated the federal Endangered Species Act by not adequately protecting the Indiana bat. The judge also ruled that the Forest Service's cliffline policies to protect bats and other rare species did not provide for the required public input and that the agency failed to prepare an Environmental Impact Statement for the sale as required by law. The Forest Service has since halted all logging on the DBNF while it reviews the ruling.

The Leatherwood sale also drew fire because of its costs—generating \$63,000 while costing the U.S. Forest Service \$93,000 in road building and other costs, according to the environmental assessment. The White House Council of Economic Advisors estimate national forest timber sales in 1995 generated \$616 million but cost \$850 million for timber management, reforestation, construction of logging roads, payments to states, and other administrative costs.²¹

The Forest Service, however, reports that timber sales on national forests generated a net revenue of \$59 million in 1995.²² A review of timber data for the DBNF shows that sales generated \$1.2 million while the timber program cost \$2.5 million in FY1995. But Forest Service officials report that timber harvests on the DBNF also support jobs and the local economy which are not factored into the cost/benefit analysis. Timber sales from the DBNF supported 459 jobs and contributed \$11.9 million to the economy in 1995. DBNF timber sales also generated \$294,261 in royalties paid to county governments in Kentucky during 1995.

Timber harvesting as well as off-road vehicle use, recreation, and ecosystem management are among the items the U.S. Forest Service will consider as it works to update the DBNF management plan as required by the National Forest Management Act of 1976. The plan will guide the management of the DBNF for the next 10 to 15 years. U.S. Forest Service officials have already received comments from more than 5,000 people. The draft plan is expected to be available for public comment in the fall of 1998.

Land Between the Lakes: Logging Issues Debated

LBL was designated a National Recreation Area in 1963 and encompasses 170,000 acres in western Kentucky and Tennessee. LBL attracts 2.5 million visits each year to camp, hike, and enjoy the area's two public lakes—Kentucky Lake and

Lake Barkley. LBL is managed by the Tennessee Valley Authority (TVA), a federal corporation set up to meet the region's electric power needs.

TVA has been exploring options for LBL to be less dependent on government funds. Federal appropriations currently support 65% of the LBL budget. Six million dollars were appropriated by Congress for LBL in 1997. The LBL budget has been flat during the past 15 years which has led to a 30% cutback in staff and the closure of one of two youth education centers.²³ Scenarios considered by TVA to help supplement the LBL budget have included lake front development, hotels, and golf courses. However, these concepts were dropped in 1996 due to public opposition.

TVA is now exploring other options to supplement the LBL budget including user fees. Timber harvests have also been used to generate revenue for LBL. Timber sales accounted for 23% of LBL's total revenue in 1996. Between 1983 and 1992, TVA sold an average of 6.6 million board feet of timber a year from LBL (**Figure 17**). However, logging was suspended at LBL in 1992 after environmentalists threatened to sue the agency for failing to comply with the National Environmental Policy Act. TVA has since developed the LBL Forest Management Plan and proposes to sell an average of 5.3 million board feet of timber a year over the next decade. This will generate about \$400,000 in net income a year.

But environmental critics are threatening to file suit to stop the timber sales which they claim will deplete the forest and spoil LBL's natural beauty. LBL officials, however, indicate that only 30% to 40% of a timber stand will be harvested amounting to an annual cut of about 38,000 trees from 2,800 acres—less than 0.2% of all trees exceeding five inches in diameter at breast height, according to LBL officials. The forest industry also contends that commercial logging in LBL helps to support jobs and local economies. The LBL Environmental Impact Statement estimated that 99 jobs were directly related to timber harvesting on LBL in 1994.

TVA has recently expressed an interest of divesting itself of all non-power programs including LBL by the year 1999. President Clinton and Congress are currently considering options to remove LBL from the authority of TVA, possibly placing it within the national park or national forest system. Governor Patton has recommended that TVA retain its management responsibilities at LBL and a task force be formed, composed of various groups, state officials, and local interests from Kentucky and Tennessee, to advise TVA officials and help oversee operations at LBL.²⁴

State Forests: Inventories, Ecosystem Management Underway

Kentucky has four state owned forests:

- Pennyriple Forest with 14,468 acres in Christian, Hopkins, Caldwell counties.
- Kentucky Ridge Forest with 11,263 acres in Bell County.
- Kentenia Forest with 3,624 acres in Harlan County.
- Tygarts Forest with 800 acres in Carter County.

The state's fifth state forest, Olympia in Bath county, was traded in 1996 for U.S. Forest Service land and offices in Rodburn Hollow in Rowan County to house the Kentucky Division of Forestry Morehead Regional Field Office.

Timber harvests on state forests were suspended in 1996 to reinventory the forests (**Figure 17**). The inventories will provide data necessary to manage the forests as ecosystems. An ecosystem is defined as the interconnections between a community of living things and the geographic environment in which they interact.²⁵

Ecosystem management focuses on the long-term conservation of natural communities while considering environmental, social, and economic consequences. An ecosystem management pilot project is underway on the Pennyriple State Forest to collect data on the forest's various ecosystems. The project will also be used to help develop ecosystem management guidelines for state forests.

Forest Wildfires: 1996 Season One of Lowest on Record

Kentucky's forests are also at risk from wildfires (**Figure 4**). The intensity and occurrence of wildfires are primarily a result of dry and windy weather conditions. Forest fire trends reveal that during 1996, private and public forestland acreage burned was among the lowest on record due to wet weather (**Figure 19 & Figure 20**). While wildfires occur in every county, the heavily forested eastern region leads the state with the most acres burned (**Figure 21**).

But too many forest fires are still purposely set. **Figure 22** reveals that during the

Figure 18 Acres Harvested on the Daniel Boone National Forest

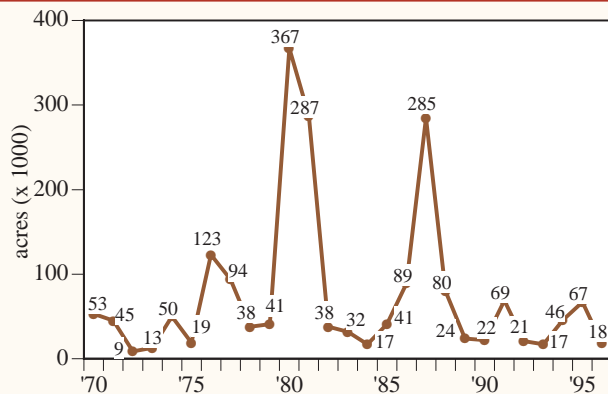
Year	Acres Logged
1986	4,200
1987	6,750
1988	6,279
1989	4,212
1990	3,456
1991	4,957
1992	4,256
1993	4,938
1994	2,507
1995	1,304
Total	42,859

Source: US Forest Service

TVA has expressed an interest of divesting itself of all non-power programs including LBL by the year 1999. Governor Patton has recommended that TVA retain its management responsibilities at LBL and a task force be formed, composed of various groups, state officials, and local interests from Kentucky and Tennessee, to advise TVA officials and help oversee operations at LBL.²⁴

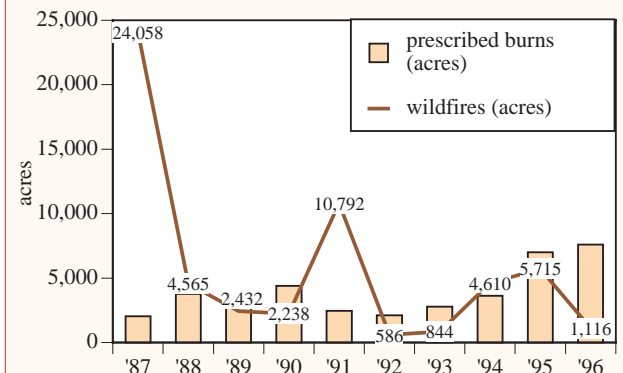
Timber harvests on state forests were suspended in 1996 to reinventory the forests. The inventories will provide the data necessary to manage these forests as ecosystems.

Figure 19 Forest Wildfires Trends in KY



Note: Excludes federal forestland. Source: KY Div. of Forestry

Figure 20 Wildfire and Prescribed Fire Trends on Daniel Boone National Forest



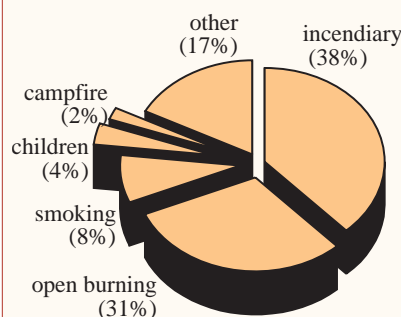
Note: Earlier data not provided. Source: U.S. Forest Service

Figure 21 Forest Acres Burned-Top 25 Counties (1970-96)

County	Acres
Floyd	205,751
Pike	164,177
Breathitt	158,490
Knott	114,080
Perry	95,708
Magoffin	95,095
Johnson	85,294
Knox	85,120
Martin	82,197
Lawrence	70,058
Harlan	65,704
Leslie	65,320
Letcher	61,249
Owsley	59,171
Whitley	47,577
Carter	40,203
Clay	39,647
Greenup	37,838
Bell	35,799
Morgan	31,593
Lee	21,870
Rockcastle	20,500
Lewis	19,945
Boyd	13,433
Ohio	12,087

Source: KY Div. of Forestry

Figure 22 Forest Wildfire Causes in KY (1980-96)



Note: Excludes federal forestland. Source: KY Division of Forestry

past 16 years, arson (incendiary) was responsible for more than one-third of the wildfires occurring in the state. A review of 1996 data shows an even more troubling statistic—that 435 or 44.4% of the 979 wildfires occurring on private woodlands were attributed to arson.

Efforts to prosecute arsonists continue. Yet, many arsonists go unpunished. From 1970 through 1996, 18,669 forest wildfires in Kentucky were attributed to arson. However, only 219 felony arson citations were issued during that time period (an average of eight per year). Sixty-seven percent of those felony arson citations resulted in a conviction. Arson is an even greater cause of fire on the Daniel Boone National Forest where it was responsible for 80% of the 70 wildfires that occurred in 1996.

In some cases fire is used as a management tool to prepare a site for tree regeneration or to support a particular habitat. Acres treated with prescribed fires have increased significantly on the Daniel Boone National Forest in recent years from 2,776 acres in 1993 to 7,591 acres in 1996 (Figure 20). U.S. Forest Service officials report that the increase is due to stepped up efforts to restore mature pine-grassland habitat for the Red-cockaded woodpecker, a federally-listed endangered bird found in the southern part of the forest. Prescribed fire is used to maintain the bird's habitat and discourage the regeneration of hardwoods.

Forest Health: Exotic Pests and Diseases Pose Threats

Kentucky's forests are also at risk from disease, insects, and pollution. One only has to look at the fate of the once abundant stands of American chestnut to see the impact disease can have on a forest ecosystem (see **Chestnut in Cove, 1910**). The chestnut blight fungus, introduced in the United States, all but wiped out this commercially valuable tree species in the 1940s.

There are a number of exotic species that threaten the health of Kentucky's forests and natural communities (Figure 23). For example, the gypsy moth, which has defoliated entire stands of forests in the Northeast, continues to move toward Kentucky. The U.S. Forest Service estimates the moth will infest the state by the year 2015 and could lead to a 60% decline in oak species. A few moths were found in

The U.S. Forest Service estimates that the gypsy moth, which has defoliated entire stands of forests in the Northeast, will infest the state by the year 2015.

Louisville and near Cincinnati in 1991 and 1992. While little can be done to prevent the invasion of the gypsy moth, monitoring and eradication of populations in the state can slow its spread.

Forest disease threats also include hemlock woolly adelgid. This disease could be devastating, resulting in the loss of the commercially important eastern hemlock while significantly altering forest ecosystems, particularly along streams and north facing slopes in eastern Kentucky.²⁶ Another forest disease threat is butternut canker. In West Virginia and Virginia, the disease has killed up to 70% of the butternut trees.²⁷ At least five counties in Kentucky have trees infected with the butternut canker. Due to its potential threat, the U.S. Forest Service has designated the butternut tree as a forest sensitive species. The agency hopes to breed disease resistant trees to help restock forests.

Ozone pollution, a pollutant associated with exhaust fumes from cars and industrial solvents, is also recognized as a growing threat to forests, leading to a decrease in tree vigor, dieback, and decline.²⁸ Ozone pollution and other stress-inducing factors including droughts are attributed to the decline of oaks across the southern Appalachians.²⁹

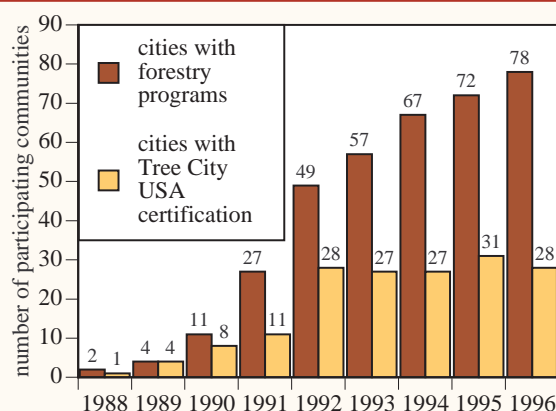
Urban Forests: Local Programs Increasing

With 52% of the state's population now residing in urban areas, interest remains high in providing urban forestry settings such as parks, greenways, and other lands to enhance recreational opportunities and improve the quality of life in a community. There are now 78 cities with urban forestry programs and 28 communities are certified as a Tree City USA (Figure 24 & 25).

Chestnut in Cove, 1910

Source: *American Lumberman*

Figure 24 Urban Forest Programs in KY



Source: KY Division of Forestry

Figure 23 Exotic Species of Concern in Kentucky

Forest Threats

Chestnut blight
Dutch elm disease
Dogwood anthracnose
Hemlock woolly adelgid
Butternut canker*

Plant Threats

Japanese honeysuckle
Kudzu
KY 31 fescue
Bush honeysuckle
Multiflora rose
Winter creeper
Asiatic bittersweet

Insect Threats

Asian tiger mosquito
Gypsy moth
Japanese beetle

Wildlife Threats

Zebra mussel
European starling

*Origin of Butternut canker unknown, may be exotic.

Source: KY Nature Preserves Commission; KY Department of Fish and Wildlife Resources; U.S. Forest Service; University of KY, Department of Forestry

Figure 25 Urban Forestry Programs in Kentucky (1996)

Anchorage*	Crestview Hills	Frenchburg	Maysville	Prestonsburg
Ashland*	Crofton	Georgetown	McKee	Princeton
Barbourville	Cynthiana	Harrodsburg*	Middlesboro	Radcliff
Bardstown*	Danville*	Hazard	Middletown	Russell Springs
Beattyville	Dawson Springs	Henderson*	Monticello	Russell
Bellevue*	Dayton	Highland	Morehead	Russellville
Benton	Dry Ridge	Heights	Mount Sterling	Seneca Gardens
Berea	Edgewood	Hopkinsville	Munfordville	Shelbyville*
Bowling Green*	Elizabethtown*	Jackson	Murray*	Southgate
Cadiz	Elkhorn City	Jamestown	Newport	Springfield
Calvert City*	Elsmere	Jenkins	Nicholasville	Warren County*
Campbellsville*	Flatwoods	LaGrange	Olive Hill	Waterson Park
Carrollton*	Florence*	Lebanon	Owensboro*	Wilder
Cold Spring*	Fort Knox*	Lexington*	Paducah*	Wilmore
Columbia	Fort Wright	Louisa	Park Hills	Winchester*
Corbin	Fort Mitchell*	Louisville*	Perryville	
Covington	Fort Thomas*	Madisonville	Pewee Valley*	
Crescent Springs	Frankfort	Mayfield	Pikeville*	

*Tree City USA communities. Source: KY Division of Forestry

Figure 26
Species Presumed
Extinct or
Extirpated from KY

Mammals

American bison
 Gray wolf
 Red wolf
 Elk
 Eastern cougar

Birds

Anhinga
 Golden eagle*
 Ivory-billed woodpecker
 Black tern*
 Carolina parakeet
 Passenger pigeon
 Am. swallow-tailed kite
 Greater prairie-chicken
 Bachman's warbler

Fish

Crystal darter
 Gravel chub
 Least darter
 Scaly sand darter
 Flame chub
 Harelip sucker
 Greater redbreast
 Blotchside logperch

Mussels

Dromedary pearly mussel
 Sugarspoon
 Angled riffle shell
 Leafshell
 Yellow blossom
 Tan riffle shell
 Acornshell
 Forkshell
 White catspaw
 Round comb shell
 Tennessee riffle shell
 Wabash riffle shell
 Cumberland leaf shell
 Tubercled blossom
 Cracking pearly mussel
 Scaleshell
 White wartyback
 Winged mapleleaf
 Rough rockshell

Reptiles

Eastern coachwhip

Insects

Robust pentagenian
 Burrowing mayfly

Plants

Marsh marigold
 Stippled scurf-pea
 Slender dragon-head
 Prairie parsley

*Extirpated as a nesting species. Source: KY Nature Preserves Commission

Biodiversity: Native Species, Natural Communities, Ecosystems

Biodiversity—the genes, species, and ecosystems making up the diversity of life on Earth—is key to sustaining humanity by providing food, clean water, shelter, and medicine while also sustaining economic, recreational, and spiritual values.³⁰ But the biological diversity of our natural communities is at risk.

A recent initiative to rank environmental and ecological risks in Kentucky identified the loss of biodiversity as a medium to high ecological risk in the state.³¹ In this section, trends and conditions affecting the health of our fish and wildlife resources, natural communities, and ecosystems will be reviewed to determine the status of Kentucky's biodiversity.

Species At Risk: 48 Native Species Extinct/Extirpated, 34 Threatened or Endangered; Habitat Loss, Pollution Principal Causes

It has been estimated that there may be upwards of 100,000 native species in the United States.³² And thousands of other species, especially insects and microorganisms, have yet to be described and classified. While the exact number of native species remains unknown, some groups of plant and animal life have been documented and are relatively well known. It is this data that provides us with a baseline from which to measure the status of Kentucky's native species.

Experts have documented that more species of plants, animals, insects, and aquatic life are now at risk than in any other period of time since the demise of the dinosaurs 65 million years ago.³³ Although most species extinctions are in areas with rich biodiversity, such as tropical rainforests, accelerated species loss is also occurring throughout the U.S. Since the time of settlement, an estimated 288 species have become extinct in this country. And The Nature Conservancy estimates that an additional 416 species may also be lost to extinction. In Kentucky, 48 native species such as the Ivory-billed woodpecker, gray and red wolf, and eastern cougar no longer exist in the state (**Figure 26**).

There are numerous reasons why species go extinct. Some are naturally rare and have been so historically. However, many extinctions have been the result of over-harvesting, pollution, and habitat alteration and destruction. In Kentucky, the primary cause of species loss in the past was unregulated hunting. This is the case for some extinct birds and mammals including the passenger pigeon and the American bison. However, more recently, habitat destruction and fragmentation, pollution, and exotic species have become the greatest threats to native species in the state.

Efforts to conserve the nation's biodiversity have focused on identifying threatened and endangered species and initiating measures to protect critical habitats under the provisions of the federal Endangered Species Act. Since the passage of the act in 1973, 5% of the 18,949 known native species of plants, fish, mussels, amphibians, reptiles, birds, and mammals in the U.S. have been federally-listed as threatened or endangered (**Figure 27**). In Kentucky, 34 or 1% of its species have been federally-listed as threatened or endangered (**Figure 27 & Figure 28**).

Federally-listed threatened and endangered species are known to occur in 78 counties (**Figure 29**). Pulaski, Whitley, Hart, Edmonson, Livingston, and McCreary counties have the greatest number of listed species. Pulaski and McCreary counties also lead the state with the greatest diversity of endangered and threatened species (plants, mammals, fish, and mussels). This may be due to the fact that this region, which includes the Cumberland River and the cliffs of the Cumberland Plateau, is considered to be one of the most biological diverse in the state.

Figure 27 Species At Risk in the U.S. and Kentucky (1997)

	vascular plants	freshwater fish	amphibians/ mussels	reptiles	birds	mammals	total
United States							
total species	16,108	822	305	520	776	418	18,949
endangered & threatened	613	106	57	46	90	64	976
rare species* (% of total)	5,267 (33%)	303 (37%)	209 (68%)	142 (27%)	248 (32%)	70 (17%)	6,239 (33%)
Kentucky							
total species	2,262	230	103	103	347	69	3,114
endangered & threatened	9	4	14	0	4	3	34
extinct/ extirpated	4	8	19	1	9	5	46
rare species** (% total)	334 (15%)	67 (29%)	41 (40%)	29 (28%)	51 (15%)	16 (23%)	538 (17%)

*Note: Does not include insects, arachnids, snails, crustaceans. *Includes species extinct, possibly extinct, critically imperiled (GH), imperiled (G2), vulnerable (G3). **Species considered rare and of special concern in Kentucky (but not all necessarily rare in other states); federally-listed threatened and endangered; extinct; and extirpated species. Source: KY State Nature Preserves Commission, The Nature Conservancy Natural Heritage Central Databases*

Native Plant and Animals: 17% Rare

There are a number of species, while not federally-listed as threatened or endangered, deemed to be rare in Kentucky. The Natural Heritage Database, the primary source of native species information in the state, currently lists a total of 538 bird, fish, mussels, plant, mammal, and amphibian/reptile species that are considered rare, of special concern, federally threatened and endangered, extinct, and extirpated—that's 17% of all these species in the state (**Figure 27**).

According to data supplied by the U.S. Fish and Wildlife Service, Kentucky ranks 12th in the nation in the number of threatened, endangered, and extirpated species (**Figure 30**). This ranking is the result of several factors including the high level of biodiversity found in the state and the extensive alteration of natural ecosystems. This has likely led to the high state ranking for species at risk.

Rare species are known to occur in almost every county of the state (**Figure 31**). The greatest concentrations have been found in the Jackson Purchase and the Upper Cumberland and Green River basins, which are considered among some of the most biologically diverse regions of the state. This may also be due to the fact that these areas have been more intensively surveyed than others in the state, and as such, are better known.

Figure 29 Federally-Listed Threatened and Endangered Species in Kentucky (1996)

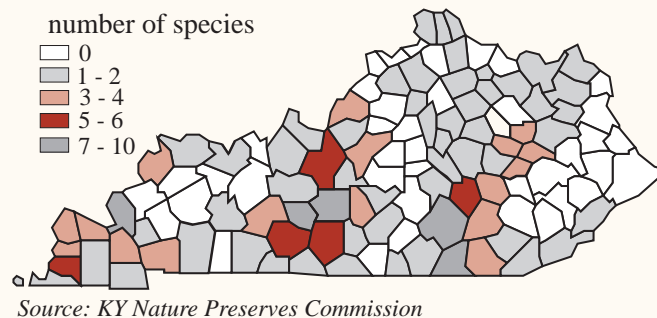


Figure 28 Threatened and Endangered Species in Kentucky (1997)

Mammals

Indiana bat
Virginia big-eared bat
Gray bat

Birds

Bald eagle
Peregrine falcon
Least tern
Red-cockaded woodpecker

Fish

Blackside dace
Relict darter
Palezone shiner
Pallid sturgeon

Mussels

Clubshell
Fanshell
Cumberland bean pearly mussel
Cumberland elktoe
Cumberlandian combshell
Little-wing pearly mussel
Pink mucket pearly mussel
Purple cat's paw mussel
Rough pigtoe
Fat pocket book
Northern riffle shell
Ring pink mussel
Orange-footed pearly mussel
Oyster mussel

Plants

Cumberland rosemary
Cumberland sandwort
Price's potato-bean
Rock cress
Running buffalo clover
Short's goldenrod
Virginia spirea
White-haired goldenrod
Eggert's sunflower

Source: KY Nature Preserves Commission

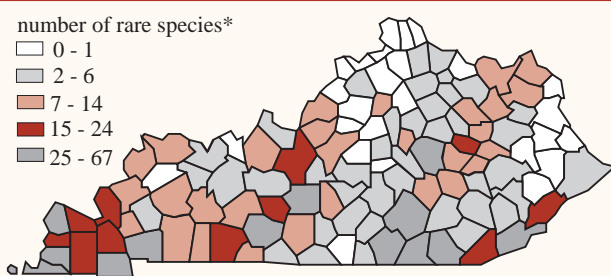
Figure 30 Top 15 States with Most At Risk Species (1996)

state	# species*	state	# species*
1. Hawaii	302	9. North Carolina	58
2. California	184	10. Georgia	56
3. Florida	97	11. Arizona	49
4. Tennessee	91	12. Kentucky	43
5. Alabama	86	13. Utah	38
6. Puerto Rico	73	14. South Carolina	38
7. Texas	72	15. Mississippi	38
8. Virginia	58		

*Includes federally-listed threatened, endangered, extirpated species. Source: U.S. Fish and Wildlife Service

For the past 20 years, the Kentucky Nature Preserves Commission has been inventorying the state for natural areas. The information collected is essential to understanding the state's biodiversity and identifying opportunities to balance conservation with human needs. However, the commission has funds to complete only two county surveys per year. At this rate, it will take another 50 years to inventory Kentucky for natural areas. To date, inventories have been completed in 17 counties and are underway in 34 (**Figure 32**). Natural area inventories are conducted using a multistep process that includes the use of aerial photos to identify potential areas, helicopter flights to confirm conditions of a site, and on-site evaluations to determine a site's significance.

Figure 31 Rare Species in Kentucky (1996)



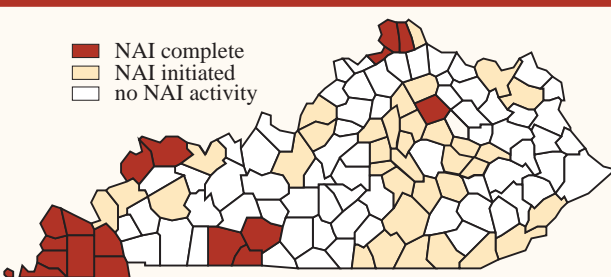
*Rare, special concern, federally threatened and endangered. Source: KY Nature Preserves Commission

Mussels: 40% of State's Native Species Rare

Freshwater mussels are the most at risk species in the U.S. and Kentucky (**Figure 27 & Figure 28**). Some 305 species of freshwater mussels are found in the U.S., which is the greatest diversity in the world. But 68% of these native mussels are now considered rare.

Kentucky has a great diversity of mussels with 103 native species, or one-third of the mussels that exist in the U.S. However, 40% of the state's mussels are rare (**Figure 28**). Threatened and endangered mussels have been found in 32 Kentucky counties (**Figure 33**).

Figure 32 Status of Natural Areas Inventory (NAI) in Kentucky (1996)

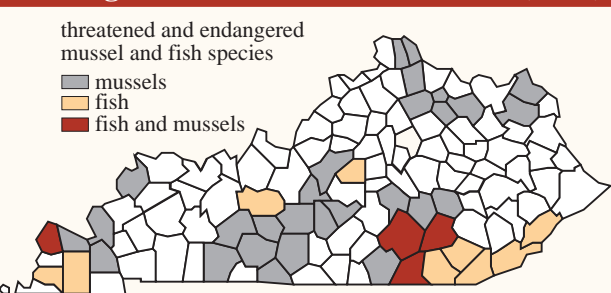


Source: KY Nature Preserves Commission

The loss of native mussels is linked to water pollution and ecosystem alterations such as dams. Another growing threat to native mussels is the exotic zebra mussel which can attach to native species and prevent feeding and reproduction. Zebra mussels have been found in several waterways including the Kentucky and Ohio rivers, Lake Barkley and Kentucky Lake.

At one time, Kentucky's rare mussels were also threatened by the harvesting of commercial species. However, during the past several years, state officials have restricted musseling in several areas where threatened and endangered species have been found. Eight mussel sanctuaries have been established and musseling is banned on certain waterways including the Cumberland, Green, and Barren rivers and in four areas of the Ohio River. Kentucky's commercial mussels are sustaining viable populations, according to state fish and wildlife officials. **Figure 34** reveals that 2,056,862 pounds of mussels were legally harvested from lakes and rivers in 1996, down from 4,844,862 pounds in 1995. Most mussels harvested in Kentucky are purchased for the cultured pearl industry in Japan. The decline in mussel harvests is attributed to limited markets for higher quality shells. Illegal poaching of mussels also remains

Figure 33 Federally-Listed Threatened and Endangered Fish and Mussels in KY (1996)



Source: KY Nature Preserves Commission

a problem, with 200 citations issued in 1996 by state law enforcement officials.

The future does not look bright for several native mussel species, according to Ronald Cicerello with the Kentucky Nature Preserves Commission.³⁴ He notes that

habitat degradation will likely continue. Future efforts to conserve freshwater mussels and other aquatic resources will depend on protecting entire watersheds. An example of such an effort is a joint initiative between The Nature Conservancy and the Daniel Boone National Forest in the Horse Lick watershed in Jackson County to purchase critical habitat to restore the endangered little winged pearly mussel and other rare species.

Freshwater Fish: 29% of Species Rare

Several species of freshwater fish are also at risk. Of the 230 fish species native to Kentucky, 29% are rare. Threatened and endangered fish occur in 13 counties in Kentucky (Figure 33). Among those is the Blackside dace, which was federally-listed as threatened in 1987. This rare three-inch fish is only found in 30 creeks in the Cumberland River Basin in Kentucky and Tennessee. Kentucky counties where the fish occurs are Bell, Harlan, Knox, Laurel, Letcher, McCreary, Pulaski, and Whitley.

Pollution is not only impacting rare fish but is also affecting the state's million dollar commercial fishing industry. Information is not available on commercial fish harvests in Kentucky, but licenses show a declining trend (Figure 35). For the eighth consecutive year, a fish consumption advisory has been issued along the 664-mile stretch of the Ohio River bordering Kentucky; a major commercial fishing river. Commercial fishing is expected to continue to decrease on open bodies of water and increase in aquaculture settings. There are currently 70 aquaculture operations permitted in Kentucky.

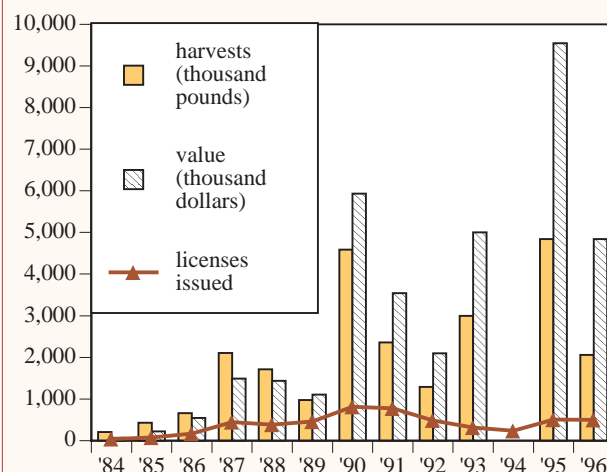
Bats: Flood Kills 3,000 Endangered Indiana Bats, Virginia Big-Eared Bats Increase Due to Cave Protection Efforts

The Indiana, Gray, and Virginia big-eared bats are the state's only federally-listed endangered and threatened mammals. Endangered Indiana bat populations continue to decline in Kentucky due to habitat loss and environmental factors (Figure 36). Populations were dealt a severe blow in 1997 when an estimated 3,000 Indiana bats hibernating at Bat Cave in Carter Caves State Resort Park drowned during the March flood.

Best available data on Gray bats in Kentucky reveal populations may be decreasing. Approximately 200,000 of these bats hibernate in one cave in Edmonson County—about one fifth of the known population. It is hoped that Gray bat populations will increase with the gating of bat's primary hibernation cave and the purchase and management of maternity caves in Allen, Adair, and Hart counties by state and federal agencies.

The only endangered bat that appears to be recovering is the Virginia big-eared bat. Populations have

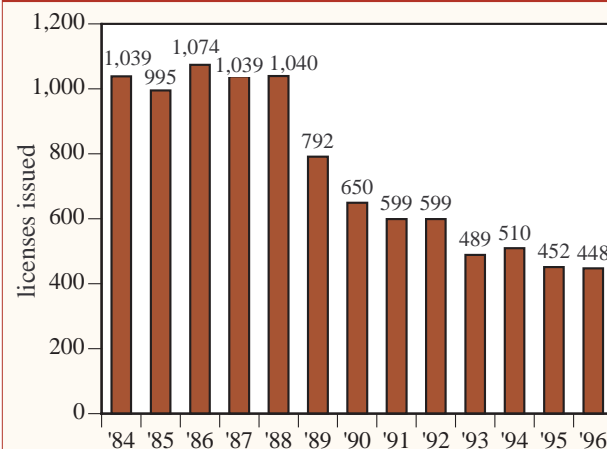
Figure 34 Commercial Mussel Harvesting Trends in Kentucky



Note: 1994 harvest and value data not available.

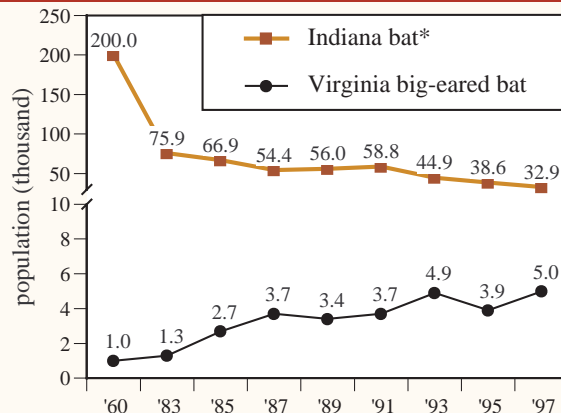
Source: KY Department of Fish and Wildlife Resources

Figure 35 Commercial Fishing License Trends in Kentucky



Source: KY Department of Fish and Wildlife Resources

Figure 36 Federally-Listed Endangered Bat Population Trends in Kentucky



*Based on bat populations at 3 primary caves - Bat Cave (Carter County), Hundred Dome and Dixon Caves (Edmonson County). 1997 populations include estimated loss of 3,000 bats due to floods. Source: KY Nature Preserves Commission

The Indiana, Gray, and Virginia big-eared bats are the state's only federally-listed endangered and threatened mammals. Indiana bat and Gray bat populations continue to decline in Kentucky. The only endangered bat that appears to be recovering is the Virginia big-eared bat due to the purchase and protection of cave habitats in Lee County.

steadily increased since 1989 after the purchase and protection of cave habitats in Lee County by the U.S. Forest Service and the Kentucky Chapter of The Nature Conservancy (**Figure 36**).

Birds: 15% of Native Species Rare; Bald Eagle Nests Produce 17 Fledglings in 1996

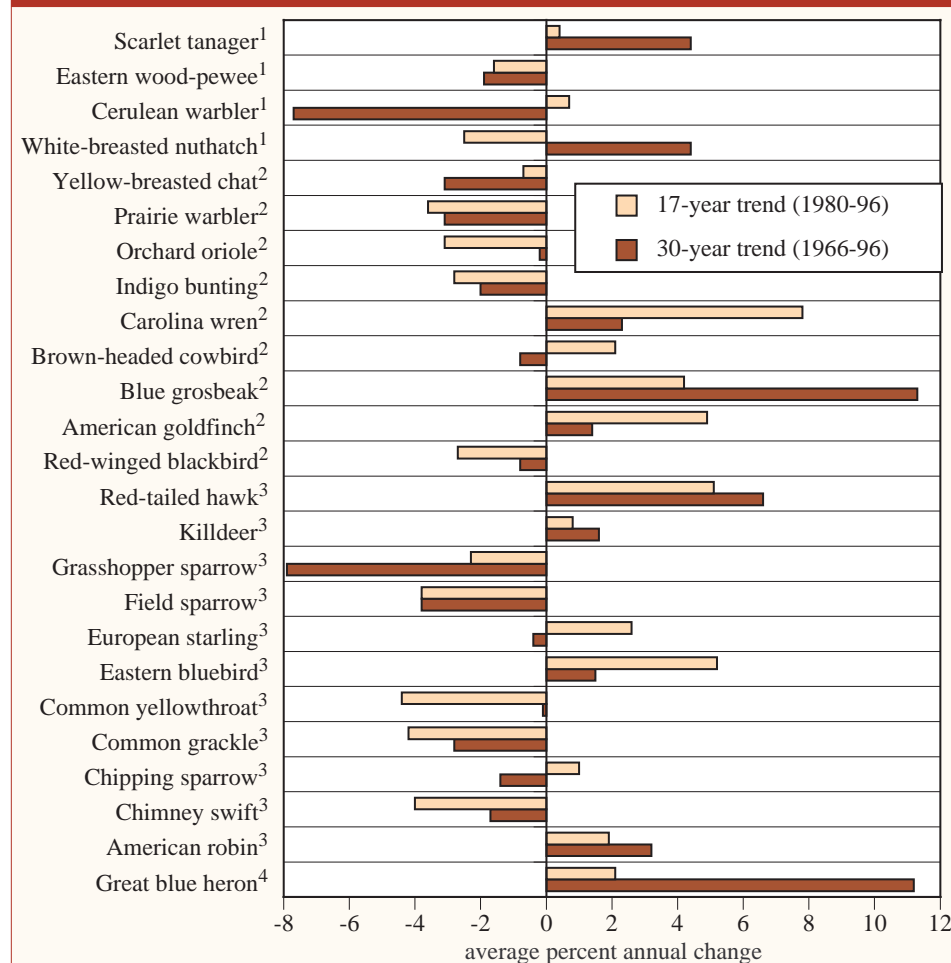
There are 347 species of birds known to occur in Kentucky, 15% of which are considered rare (**Figure 27**). The best overall data on bird population trends in the state are collected as part of the national North American Breeding Bird Survey. While the survey is limited by several factors including small sample size, it still serves as an important tool to identify native bird species at risk.

The Breeding Bird Survey reveals that 28 of the 83 bird species with a statistically valid sample size show a long-term (30-year) decline in populations in Kentucky while 20 species are increasing with the remainder showing no significant change. It is difficult to determine why various bird species are declining since there are many complex factors affecting populations including weather, pollution, food supply, and changes in land use. However, unquestionably one of the most significant factors in the decline of many migratory songbird species is habitat loss. For some species, like the Cerulean warbler, which has declined an average of 7.7% annually for the past 30 years, loss and fragmentation of breeding grounds (mature

hardwood bottomland forests) and wintering habitat (tropical forests of South America) have contributed to the decline (**Figure 37**). Some grassland birds, like the Grasshopper sparrow, may also be declining in Kentucky due habitat loss and conversion of grassland to row crops.

Efforts to restore federally-listed endangered and threatened bird species found in Kentucky continue with mixed results (**Figure 38**). One of the most successful bird recovery efforts to date has been the Bald eagle. In fact, national efforts have been so successful that the federal government in 1995 upgraded the status of the bird from endangered to threatened. There are now 4,500 nesting pairs of Bald eagles nationwide, up from 417 in the 1970s. The banning of DDT along with laws to protect habitat and prohibit hunting are credited for the comeback of the Bald eagle.

Figure 37 Selective Bird Population Trends in Kentucky



Note: Species with statistically significant long-term or short-term trends. ¹Woodland habitat.

²Brush/mixed habitat. ³Farm/open land habitat. ⁴Water/marsh habitat.

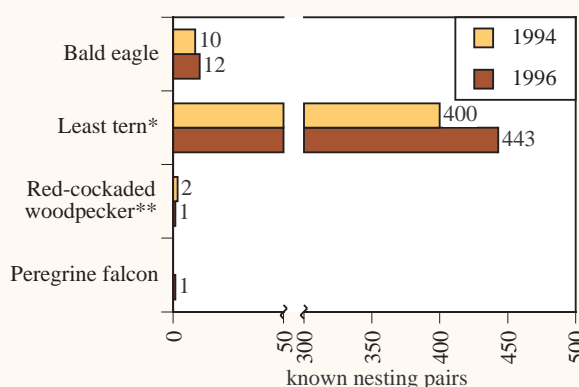
Source: U.S. Fish and Wildlife Service Breeding Bird Survey; KY Nature Preserves Comm.

In 1996, there were 12 nesting pairs of Bald eagles located in Ballard, Carlisle, Fulton, Henderson, Hickman, Lyon and Trigg counties. Eight of these nests produced 17 fledglings in 1996 and Bald eagles are now considered to be capable of sustaining a viable population in the state.

But efforts to restore other federally-listed bird species in Kentucky have not been as successful, including those to restore the endangered Red-cockaded woodpecker. The U.S. Forest Service hopes to improve the chances for recovery of the woodpecker with measures to enhance the bird's mature pine-grassland community on the Daniel Boone National Forest. Among the measures to be used are prescribed fire and the removal of midstory trees. There is one nesting pair of woodpeckers on the forest (**Figure 38**).

State officials also hope to reestablish the Peregrine falcon in Kentucky. Between 1993 and 1996, 46 falcons were released in Lexington and at Lake Herrington. The goal is to establish at least three breeding pairs in the state. A pair of Peregrine falcons from similar efforts in nearby states has taken up residence in Louisville and has successfully bred there since 1995 (**Figure 38**).

Figure 38 Status of Endangered and Threatened Bird Species in Kentucky



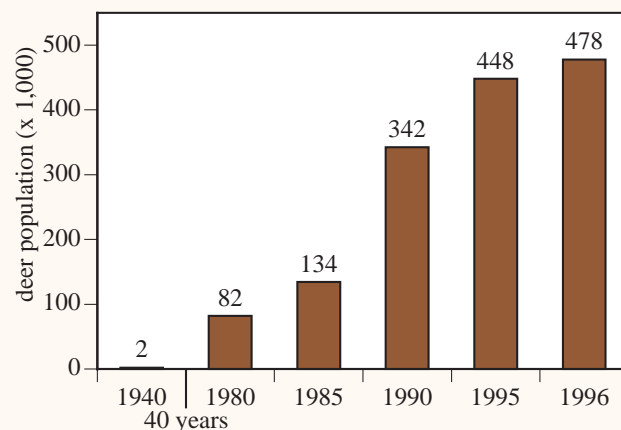
*Note: Earlier and historic data not available. *Based on site surveys and estimates. **1997 data shown for 1996. Source: KY Nature Preserves Comm.; KY Dept. of Fish and Wildlife Resources; U.S. Forest Service*

White Tail Deer: Populations Reach All Time High

Some of the most successful wildlife restoration efforts have been for game species. For example, white tail deer populations reached an all time high in 1996 at 478,000. This is a significant increase since 1940 when unregulated hunting reduced deer populations to 2,000 (**Figure 39**).

The distribution of deer ranges from a low of 485 in Fayette County to a high of 13,861 in Carter County (**Figure 40**). The largest concentrations of deer are in the west central region of the state. This is attributed to a patchwork of habitat including soybean and corn fields, reclaimed strip mines, and forestland. White tail deer populations are expected to increase in the east and remain stable in the west. While state officials estimate that sustainable deer populations could reach as high as 1.7 million, the state goal is to control populations not to exceed 807,000.

Figure 39 White Tail Deer Trends in Kentucky



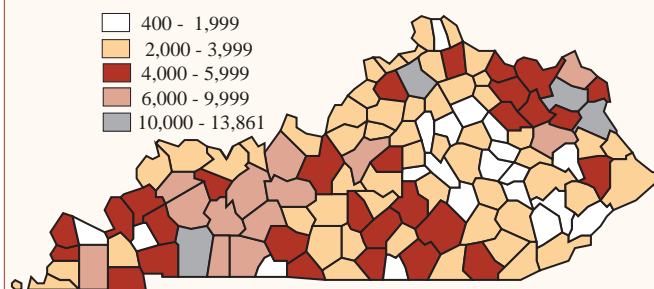
Source: KY Department of Fish and Wildlife Resources

Wild Turkey: Populations Increase From 70,000 in 1994 to 106,000 in 1996

Another game species that has made substantial gains from near extirpation levels is the wild turkey. In 1959, only 800 wild turkeys were known to exist. State restoration efforts, which began in 1978, resulted in the release of 6,750 turkeys at 430 sites across the state. By 1996, turkey populations had increased to 106,000 (**Figure 41 & Figure 42**). State officials estimate that wild turkey populations will likely peak in the next ten years at 200,000 to 250,000 birds.

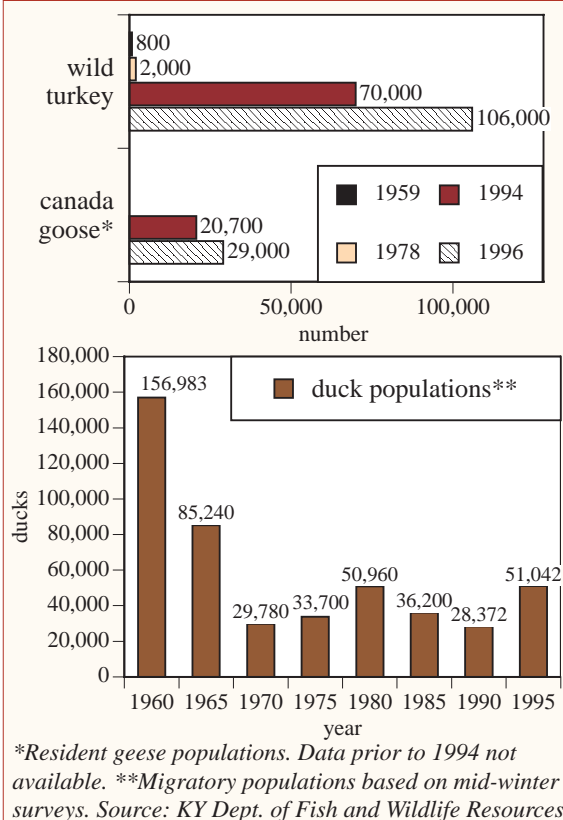
Kentucky has also become home to a growing number of resident Canada geese (**Figure 41**). Flocks of resident geese were established from releases that oc-

Figure 40 White Tail Deer Populations (1996)



Source: KY Department of Fish and Wildlife Resources

Figure 41 Wild Turkey, Canada Goose, Duck Trends in Kentucky



occurred across the state in the late 1970s and early 1980s. Surveys also reveal that duck populations have increased since the 1970s. The decline of duck populations in the past is attributed to the accelerated loss of wetlands and bottomland forest habitat, according to state fish and wildlife officials. Wetland conservation and protection of important habitats have contributed to an increase in duck populations in Kentucky since the 1970s (Figure 41). The decline in duck populations during 1985-1990 is attributed to droughts that affected habitat.

Rabbit, Quail, Grouse: Habitat Loss Results in Long-Term Decline, Present Populations Stable

The state also monitors populations of grouse, cottontail rabbit, and quail; three other popular game species. Populations of quail and rabbit steadily declined between 1970 and 1980 (Figure 43). The decline in rabbit and quail populations is largely attributed to loss of habitat and a shift in vegetation on hay and pasturelands from native grasses to species like KY 31 Tall Fescue which provides little nutritional or nesting value to rabbits and quail. In fact, fescue can be toxic to rabbits inflicting the animal with an endophyte fungus when consumed. KY 31 Tall Fescue is now the dominant vegetation on hay and pastureland in Kentucky. Since the mid-1980s quail and rabbit populations have been fairly stable.

Grouse populations are declining in the Southern Appalachian states based on long-term monitoring data. While grouse population trends cannot be fully assessed in Kentucky since data have only been collected since 1988, some experts believe that a similar trend is occurring (Figure 43). Grouse populations have been declining in recent decades due to a loss of habitat. Grouse thrive in young forests, but most of Kentucky's woodlands are now more than 60 years old.

Figure 42 Wild Turkey Populations

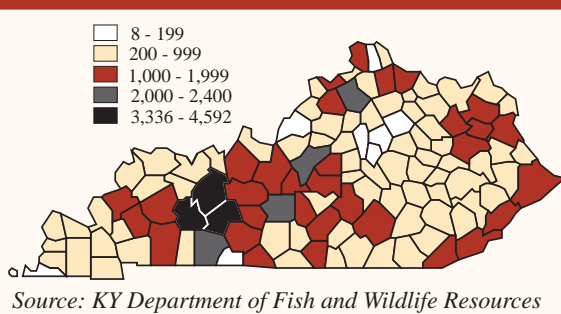
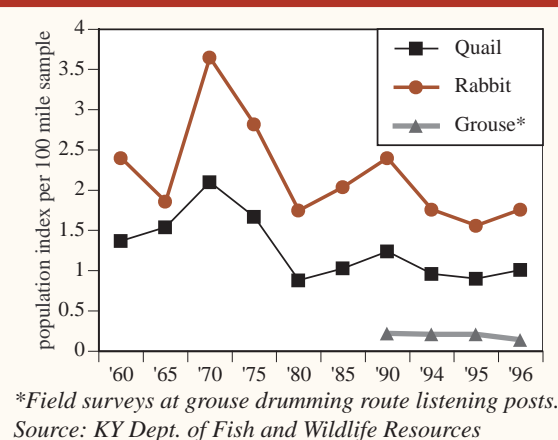


Figure 43 Quail, Rabbit, Grouse Population Trends in Kentucky



Osprey, Otter, Bear, Elk: Restoration Underway

Federal and state efforts are also underway to restore osprey, elk, black bear, and river otter in Kentucky. Between 1981 and 1991, 133 osprey were released at Land Between the Lakes (LBL), Laurel Lake, and other sites. Osprey is considered to be on the road to recovery in Kentucky with 20 active nests in 1996.

LBL and Tennessee officials have proposed releasing 260 elk over a four year period in the Tennessee portion of LBL. This will likely recolonize elk in the Kentucky portion of LBL. And state fish and wildlife officials plan to release 1,800 elk in 14 southeastern Kentucky counties during the next nine years, beginning in 1998. Last year, federal officials also released a dozen black bear in the Big South Fork National Recreation Area on the Kentucky-Tennessee border to determine if the bears will adapt to the area.

The Kentucky river otter restoration program began in 1991. Once abundant in Kentucky, river otters fell victim to

unregulated harvesting, habitat destruction, and pollution. During 1991-1995, state officials released 355 otters at 14 sites in the eastern Kentucky. Because monitoring river otter populations is difficult, the success of the restoration effort to date is not fully known.

Ecosystems: Old-Growth Forests Among Most Endangered

Kentucky's biological resources are dependent upon the health of the ecosystems which they inhabit. But much of Kentucky's natural ecosystems have been altered. It has been estimated that less than one-half of one percent of Kentucky remains in an undisturbed state.³⁵ Kentucky, along with other southern states, has the greatest number of endangered ecosystems in the nation, according to the National Biological Service.³⁶

Some ecosystems are more threatened than others (**Figure 44**). For example, Kentucky once had two million acres of tallgrass prairie, but less than 200 acres remain. Several forest ecosystems are endangered as well. A 1994 survey by The Nature Conservancy reveals that Kentucky has six endangered forest ecosystems.³⁷ One of the most threatened is the Bluegrass Woodland Savanna. This ecosystem once covered central Kentucky but now only a few remnants remain.³⁸

Kentucky's old-growth forests are also endangered. Old-growth forests are those that have characteristics of pre-settlement conditions with minimal human disturbance. Close to 90% of Kentucky was once covered by forests. Today, about half of the state's land remains forested; virtually all of which is second or third growth. The only known tracts of old-growth forest of any size left in the state are Blanton Forest (2,350 acres in Harlan County), Lilley Cornett Woods (252 acres in Letcher County), and Big Woods (200 acres at Mammoth Cave National Park in Edmonson County) (**see Efforts to Save Kentucky's Old Growth Forests Continue**).

Wetland Ecosystems: 75% of Original Acreage Destroyed

Bottomland hardwood forests are also ranked as one of the state's most endangered ecosystems due to the conversion of wetlands to other uses. It is estimated that Kentucky once had 1.6 million acres of wetlands. By 1977, 929,000 acres had been drained and converted to farmland and other uses. Today, only 400,000 acres of wetlands remain in Kentucky, 20% of which is forested.³⁹ The greatest wetland losses occurred in Western Kentucky where 52% of the state's bottomland forests were cleared between 1957 and 1974.

Wetland ecosystems not only provide critical habitat to many endangered species and waterfowl, they reduce the severity of floods and improve groundwater

Figure 44 Most Endangered Ecosystems in Kentucky

Bluegrass woodland savanna
Mountain bogs
Tallgrass prairie
Glades
Old-growth forests
Bottomland hardwood forests
Wetlands
High quality aquatic systems

Source: KY Nature Preserves Commission; KY Division of Water; KY Biodiversity Task Force

Efforts to Save Kentucky's Old-Growth Forests Continue

State conservationists continue to work to protect the few tracts of old-growth forests left in Kentucky. Private fund-raising efforts matched by state monies have generated \$219,000 to purchase 1,425 acres of old-growth forest contained in the 6,500 acre tract making up Blanton Forest in Harlan County. An additional \$300,000 has been set aside by the Kentucky Natural Land Trust to help manage the forest. The Kentucky Nature Preserves Commission is currently negotiating with landowners in an attempt to acquire additional tracts of the Blanton Forest.

However, the protection of Lilley Cornett Woods in Letcher County remains uncertain. The state purchased the 550-acre tract in 1969 to preserve the 252 acre old-growth forest. The forest currently serves as a research site and outdoor laboratory for Eastern Kentucky University. While the right to strip mine the coal under the woods was ceded to the state by the coal companies that held them, underground mining rights have remained in private hands.

The two companies that own the underground mining rights—DLX and Enterprise Resources—have been denied permits to mine the coal based on potential subsidence and impacts to underground water supplies. However, DLX Inc. filed a lawsuit in 1997 alleging that the permit denial was a unconstitutional taking of its property. The company is seeking compensation of \$5 million, the value it alleges the coal is worth. Kentucky officials are currently assessing the extent of mineable coal reserves on the Woods contending the value is far less than \$5 million.

Enterprise Resources is also seeking one million dollars from the Eastern Kentucky University to buy its minerals beneath the forest. The University has applied to the Heritage Land Conservation Board for funds to purchase the minerals. The board, however, has asked the university to assess the amount of recoverable coal prior to consideration of the application.

There has been a net gain in wetlands in Kentucky during the past five years. Between 1991 and 1996, 1,105 acres of wetlands were converted to non-wetland status under a Clean Water act permit while 2,329 acres were created or restored.⁴⁰

Mammoth Cave National Park: An International Biosphere Reserve

The 52,830 acre Mammoth Cave National Park (MCNP), located in central Kentucky, has the most extensive cave system in the world, with more than 345 surveyed miles of cave passageways.

MCNP attracted nearly two million visitors in 1996 and contributed \$116 million in spending to the local and regional economy. But just as important, MCNP is an important and fragile ecosystem providing habitat to 1,000 plant and 700 animal species.

MCNP was designated an International Biosphere Reserve, one of 41 in the U.S. and 70 in other countries, in 1990 because of its unique natural environment. Each biosphere reserve represents a place for research, monitoring and education. Among the initiatives underway at MCNP are:

- Water Quality Project - a partnership with farmers, universities, and others to protect the Mammoth Cave watershed by promoting sustainable agriculture.

- Economic Studies - a joint project with the West Kentucky Corporation to assess suitable/unsuitable development sites near the park and formulate regional sustainable tourism plans.

- Fire Management Plan- The Nature Conservancy has been contracted to develop a plan to address wildfires and the reintroduction of prescribed fire at the park to promote native grassland communities.

quality by filtering contaminants. National and state efforts to conserve wetlands were initiated in the 1980s and 90s. Among the measures was a nationwide policy, adopted in 1991, that specifies no net loss of wetlands. Federal and state regulations require that for every acre of wetland destroyed, two or more acres must be created to compensate for the loss. On a national level, the country has yet to reach its goal of no net loss of wetlands, but experts expect to meet this goal in the near future.⁴⁰ In Kentucky, there has been a net gain in wetlands in the past five years. Between 1991 and 1996, 1,105 acres of wetlands were converted to non-wetland status under a Clean Water act permit while 2,329 acres were created or restored.⁴¹

Another national initiative to conserve wetlands is the federal Wetland Reserve Program. Under this program, the federal government compensates farmers who set aside original wetland acreage from farming in an effort to restore these important ecosystems. Since 1991, 325,000 acres have been enrolled in the Wetland Reserve Program nationwide —1,700 acres of which are in Kentucky.⁴²

Aquatic Ecosystems: 1.2% of Waterways Considered High Quality

High quality waterways are also on the list of most endangered ecosystems in Kentucky. Most waterways have been degraded by pollution, impairing their ability to fully support healthy and diverse communities of aquatic life.

Nationwide, 2% of the country's streams are clean enough to be designated as wild rivers.⁴³ In Kentucky 1,044 miles of waterways are deemed of high enough quality to be classified as Outstanding Resource Waters, Reference Reach Streams, State Wild Rivers, or National Wild and Scenic Rivers.⁴⁴ This is 1.2% of the 89,431 miles of waterways in the state. The Upper Cumberland basin has the greatest number of high quality waterways in the state with 541 designated miles.

Many experts agree that watershed-based management is the best approach to preserving aquatic ecosystems. The Division of Water has embarked on a watershed pilot project in the Kentucky River basin. The goal is to collect data and work with local communities to restore water quality across the watershed.

Cave Ecosystems: Habitat to 50 Rare and Endangered Species

Caves are important but vulnerable ecosystems. There are 3,800 mapped caves in 87 counties in Kentucky.⁴⁵ These include the Mammoth Cave, the most extensive cave system in the world (**see Mammoth Cave National Park**). Caves provide habitat to nine of the state's federally-listed threatened and endangered species and another 39 rare ones.⁴⁶

Caves are threatened by pollution and vandalism. Federal and state efforts to gate and protect caves have helped. But just last year, a federal judge sentenced three people to prison and three people to 500 hours of community service after they were caught removing 600 pounds of cave formations from the Floyd Collins' Crystal Cave in Mammoth Cave National Park and selling these to gift shops in the area for a dollar a pound.⁴⁷ Damage to the cave exceeded \$100,000 and destroyed some of its most rare formations. Eight gift shops were also cited by the State Police for selling the stolen cave formations, a misdemeanor under state law since 1988. State police admit, however, that enforcement of Kentucky's cave protection laws has been a low priority and more should be done to protect this important natural resource.

The good news is that several polluted caves are being restored. For example, Hidden River Cave, a famous tourist attraction near Horse Cave, was severely polluted by sewage.⁴⁸ By the 1980s, federal agencies and local citizen groups began working to address the pollution problems at the cave. A new regional sewage treatment plant was built which has aided in the recovery of the river and cave.

Natural Areas: 9% of State's Land Managed as Natural Areas

According to the Kentucky Natural Heritage Database, 2,225,450 acres of land, about 9% of the total state acreage, is considered to be managed as natural areas (**Figure 45**). But the level of protection of these lands varies. For example, only 107,996 acres of these natural areas (0.4% of the state's acreage), are considered fully protected. These include the state's 35 nature preserves (**Figure 46**), federal wilderness areas, and land owned by The Nature Conservancy.

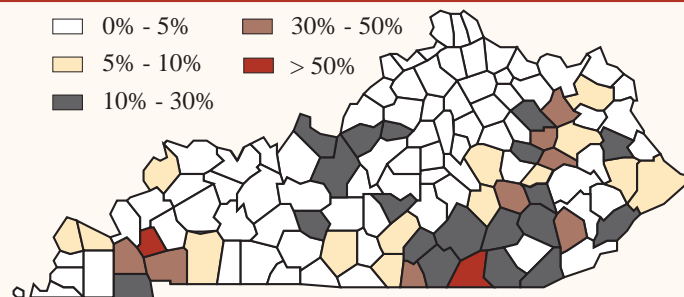
Other natural areas in Kentucky are identified as managed but not necessarily protected from human disturbance. These include 33 state wildlife management areas (**Figure 47**), university lands, and much of the 690,987 acres of the Daniel Boone National Forest.

Private efforts to set aside natural areas have also been initiated by several companies in Kentucky including Cyprus-Amox (16,000 acres), Kimball International (3,200 acres), Peabody Coal (30,000 acres), and Westvaco (30,000 acres). The Kentucky Business Conservation Partnership was also recently created by the Kentucky Chamber of Commerce, Economic Development Cabinet, and the Department of Fish and Wildlife Resources to promote stewardship on industry land. Charter members include Commonwealth Aluminum, Hampshire Chemical, National Southwire, Willamette Industries, Alcoa, and World Source Coil Coating.

The Department of Fish and Wildlife Resources also works with private landowners to create high quality habitat. Between 1987 and 1996, the agency assisted 3,252 landowners manage 738,680 acres under the state Habitat Improvement and Kentucky Stewardship Incentive programs.

Federal efforts are also underway to purchase 20,000 acres along the East Fork of Clarks River in western Kentucky to create a National Wildlife Refuge. Clarks River is one of the few remaining unchannelized bottomland hardwood ecosystems remaining in Kentucky. The protection of the area is expected to enhance and protect an important part of the Mississippi flyway corridor—the largest corridor for migratory waterfowl and birds. The cost to purchase land in the Marshall, McCracken, and Graves counties is estimated at \$15 million. Congress has appropriated \$3 million to fund the first year of acquisition which is expected to begin in late 1997 or 1998.

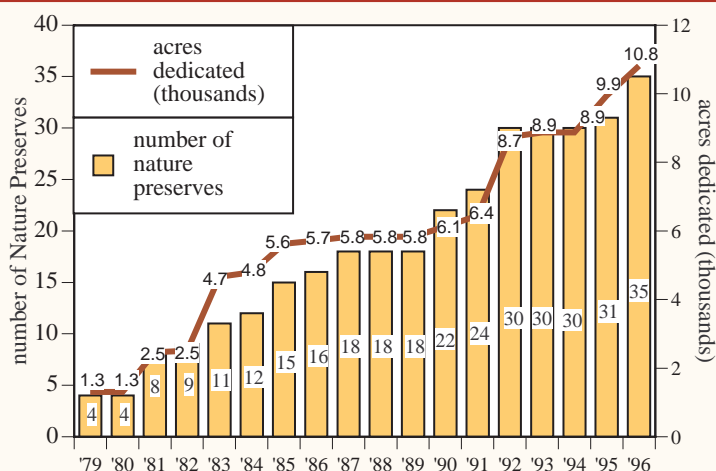
Figure 45 Managed Natural Areas in KY (1996)



Note: Includes federal, state, private land either protected, semiprotected, or unprotected but managed as a natural area.

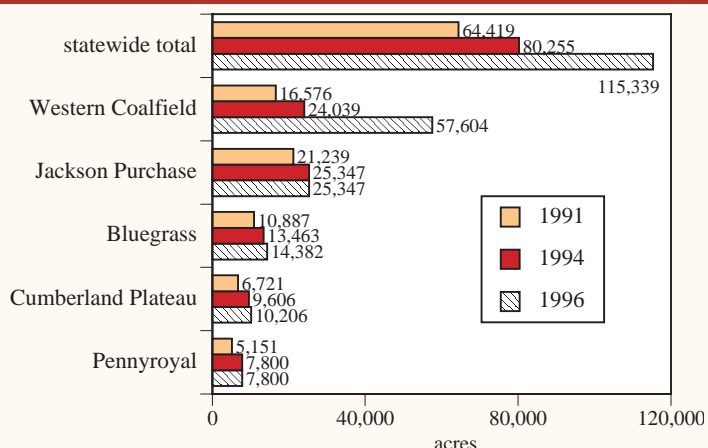
Source: KY Natural Heritage Database

Figure 46 State Nature Preserves in Kentucky



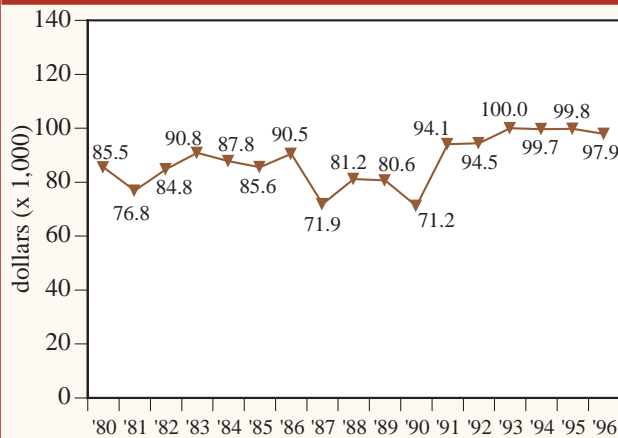
Source: KY Nature Preserves Commission

Figure 47 Wildlife Management Areas in Kentucky



Source: KY Department of Fish and Wildlife Resources

Figure 48 Donations to Kentucky Income Tax Checkoff Nature and Wildlife Fund



Source: KY Nature Preserves Commission

Heritage Land Conservation Fund Generates \$12 Million to Purchase Natural Areas

Kentucky has primarily relied on the generosity of its citizens to purchase important natural areas. The only funding source for many years was donations made to the Kentucky Income Tax Checkoff Program Nature and Wildlife Fund (Figure 48). The Kentucky Nature Preserves Commission and the Department of Fish and Wildlife Resources divide the proceeds from the program to support a variety of programs.

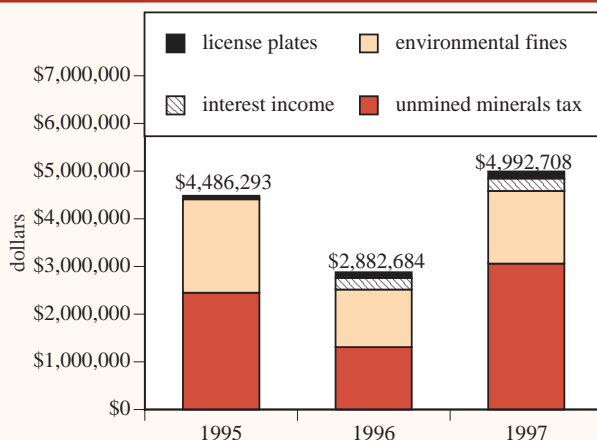
However, in recent years, Kentucky has taken great strides to improve the protection of natural areas. The Kentucky Heritage Land Conservation Fund was created in 1990 and funded by the Legislature in 1994 to provide a permanent source of monies to purchase natural areas from willing sellers. The fund is managed by a board appointed by the governor.

The fund is financed by revenues from the state portion of the unmined minerals tax, environmental fines, the sale of nature license plates, and interest earned on undistributed funds (Figure 49). The sale of 18,243 nature license plates has generated \$310,000 since 1995 and has become one of the most popular specialty license plates in the state. The yearly fluctuations of the fund are attributed to a backlog in the collection of the unmined minerals tax.

Priority for land purchases is given to natural areas that possess unique features such as rare, endangered, and migratory bird habitat; areas that perform important natural functions such as wetlands; and areas to be preserved in their natural state for public use, outdoor recreation, and education.

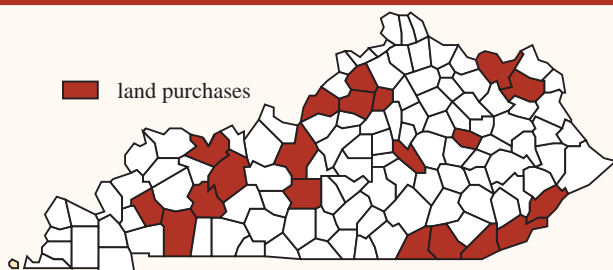
Half of the fund is allocated to five state agencies: Nature Preserves Commission, Division of Forestry, Department of Fish and Wildlife Resources, Department of Parks, and the Wild Rivers Program. The remainder is made available to state agencies, local governments, state colleges, and universities. As of March 31, 1997, the fund had generated \$12.3 million. To date, 26 natural areas totaling 15,521 acres in 20 counties have been or in the process of being purchased at an estimated cost of \$8.1 million (Figure 50).

Figure 49 KY Heritage Conservation Fund



Source: KY Heritage Land Conservation Fund Board

Figure 50 KY Heritage Land Conservation Purchases (Jan. 1995- March 31,1997)



Note: Lands purchased and lands approved for purchase.

Source: KY Heritage Land Conservation Fund Board

Copperbelly Snake Agreement Offers New Cooperative Approach to Protecting Critical Habitats in Kentucky

The national debate on how best to protect rare species and critical habitats has given way to the notion of managing ecosystems in a more holistic and proactive manner. As such, the country has begun to move away from the more prescriptive measures as specified in the federal Endangered Species Act to the use of voluntary conservation agreements.

In January 1997, such an agreement was signed by state, federal, and private interests to protect the rare copperbelly water snake. The agreement sets out a frame-

work for protecting the snake's wetlands habitat in western Kentucky and southern Indiana and Illinois. In return, the U.S. Fish and Wildlife Service will not list the southern populations of the copperbelly water snake as a threatened species under the federal Endangered Species Act.

Since most of the snake's remaining habitat in Kentucky is in 14 western coalfield counties (Butler, Caldwell, Christian, Crittenden, Daviess, Hancock, Henderson, Hopkins, Logan, McLean, Muhlenburg, Ohio, Union, Webster counties), coal companies have agreed to avoid, curtail, or modify mining in some key snake areas and implement reclamation practices after mining to enhance habitat. State agencies in Illinois, Indiana, and Kentucky have also agreed to place a high priority on acquiring and improving copperbelly water snake habitat, avoiding the degradation of wetlands unless mitigation is carried out, and conducting research on the snake.

Biodiversity Council Coordinates Efforts to Conserve Natural Resources

The Kentucky Biodiversity Council was created in 1995 by Executive Order to coordinate efforts to conserve the state's natural resources. The Council was among the recommendations of the Biodiversity Task Force, a 34-member board established by Governor Brereton Jones in 1994 to assess biodiversity status and needs. The task force developed 16 strategies and 40 action plans to sustain biodiversity (**Figure 51**). The Biodiversity Council is currently working to coordinate the collection and mapping of natural resource data in Kentucky. In addition, the group is working to educate the public about biodiversity through a bi-yearly newsletter.

Figure 51 Elements to Sustaining Biodiversity in KY

- Conduct a comprehensive inventory of biodiversity in Kentucky.
- Establish a sustained public education program about the values of biodiversity.
- Promote incentives to support biodiversity on private lands.
- Support economic development strategies that promote sustainable industries.
- Coordinate statewide efforts to conserve biodiversity.

Source: Kentucky Alive!

Report of the KY Biodiversity Task Force, 1995

References

1. KY Nature Preserves Commission (1996). Plant and Animals Presumed Extinct or Extirpated from Kentucky. Transactions of the KY Academy of Science 57:69-91.
2. U.S. Natural Resources Conservation Service. KY's Land Resources Conditions Trends. 1992.
3. Per Bill Craddock, State Soil Scientist, Natural Resources Conservation Service (7/3/97).
4. U.S. Natural Resources Conservation Service. KY's Land Resources Conditions Trends. 1992.
5. Ibid.
6. U.S. Forest Service Survey of 1987 indicates 48% (12.7 million acres) of Kentucky's land area is covered by private and public forests while the U.S. Natural Resources Conservation Service 1992 Natural Resources Inventory found 45% (11.5 million acres) of the land area covered by forests.
7. U.S. Forest Service conducts forest inventories of all states. Inventories in Kentucky have been conducted in 1949, 1963, 1975, and 1987. The next inventory for Kentucky is planned in 1999.
8. KY Roundtable on the Economy and the Environment (1996). Kentucky's Forest Products and Resources: A Time for Wise Choices (Nov. 1996).
9. KY Biodiversity Task Force (1995). Kentucky Alive!
10. U.S. Forest Service (1996). Private Forestland Owners of the U.S. 1994.
11. U.S. Forest Service (1988). Forest Statistics for Kentucky (1975 and 1988).
12. U.S. Department of Commerce, Bureau of Census. Annual Surveys of Manufacturers (1967-94).
13. Matthew H. Pelkki, Assistant Professor, Univ. of Kentucky, Department of Forestry (4/10/97).
14. Sawtimber log grades from U.S.F.S. Forest Statistics for Kentucky 1975 and 1988. Table 38.
15. KY Roundtable on the Economy and the Environment (1996). Kentucky's Forest Products and Resources: A Time for Wise Choices (Nov. 1996).
16. 306,900 forest landowners per U.S. Forest Service Private Forestland Owners of the U.S. 1994.
17. National Hardwood Lumber Association (1994). Sustainable Forest Policy of the NHLA.
18. Loggers based on U.S. Census (1990). Employment Statistics for Kentucky.
19. Crit Luallen (1994). Paper entitled "Long Term Future of Tourism." (Feb. 8, 1994).
20. Ibid and conversation with Larry Southard, KY Tourism Cabinet.
21. Council of Economic Advisors (1997). Economic Report to the President, p. 217-218.
22. U.S. Forest Service (1996). Timber Sale Program Annual Report (FY1995).
23. James Malone, Courier Journal. Environmentalists oppose TVA plan to cut more trees (5/6/97).
24. Governor Paul E. Patton, Prepared Statement before the U.S. House of Representatives, 3/1/97.
25. BNA Environmental Reporter (1996). "Ecosystem Approach Touted as Sensible Method for Dealing with Environmental Problems of the Future." (Vol. 27, p. 826-827).
26. Natural Resources and Environmental Protection Cabinet (1996). Kentucky Outlook 2000, Executive Summary, May 1997.
27. Telephone conversation with Bob Anderson, U.S. Forest Service, Southeast Regional Office.

References - continued

28. Dr. Robert I. Bruck, et al. Effects of Acid Deposition on Forest Resources in Kentucky (2/1988).
29. Stringer, Kimmerer, Overstreet, Dunn (1995). Oak Mortality in Kentucky.
30. The Nature Conservancy (1996). Priorities for Conservation: 1996 Annual Report Card for U.S. Plant and Animal Species.
31. KY Natural Resources and Environmental Protection Cabinet. Kentucky Outlook 2000, Executive Summary (draft 11/96).
32. The Nature Conservancy (1997). Species Report Card.
33. Ibid.
34. Ronald Cicerello (1996). "Why Freshwater Mussels are Becoming as Rare as Hen's Teeth." Nature Conservancy Kentucky News (Summer 1996).
35. Marc Evans (1996). "The Kentucky Natural Areas Survey." Naturally Kentucky (#17, Jan/Feb/March 1996).
36. Reed Noss, Edward T. LaRoe, J. Michael Scott, National Biological Service (1995). Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation; p. 8.
37. KY Biodiversity Task Force (1995). Kentucky Alive!
38. Bryant, et al (1980). The blue ash-oak savanna-woodland, a remnant of pre-settlement vegetation in the Inner Bluegrass of KY
39. Kim Haag, Charles Taylor (1997). Kentucky Wetland Resources (U.S. Geological Survey -Water Supply Paper 2425).
40. BNA Environmental Reporter (1996). "Enhancement Out Pace Loss of Resources, Policy Group Says." (Vol. 27, #50, p. 2646).
41. KY Division of Water (1997). Memo from John Dovak regarding status of wetlands in Kentucky (4/15/97).
42. Ibid and U.S. Dept. of Agriculture. USDA's Wetland Reserve Program Sign-up Begins Today (Oct. 1, 1996).
43. KY Biodiversity Task Force (1995). Kentucky Alive!
44. As designated by the Kentucky Division of Water.
45. KY Geological Survey. Caves and Karst of Kentucky, 1985
46. KY Nature Preserves Commission. Naturally Kentucky Number 22, April, May, June 1997, p. 2.
47. Andrew Melnykovich, The Courier-Journal; and Mammoth Cave National Park (1996-97).
48. Julian J. Lewis (1994). "Life Returns to Hidden River Cave, the Rebirth of a Destroyed Cave System." American Cave Adventures (Fall 1994).

Kentucky Environmental Quality Commission

14 Reilly Rd.
Frankfort, KY 40601
Telephone: 502-564-2150
Fax: 502-564-4245 ■ E-mail: EQC@mail.nr.state.ky.us
EQC web site: <http://www.state.ky.us/agencies/eqc/eqc.html>

State of KY's Environment

To receive all seven reports of the 1996-97 *EQC State of Kentucky's Environment* series send a \$10 check, payable to the Kentucky State Treasurer, to:
Environmental Quality Commission
1996 State of KY's Environment Series
14 Reilly Rd.
Frankfort, KY 40601

Acknowledgments

Prepared by Leslie Cole, Executive Director, Scott Richards, Assistant Director, and Erik Siegel, Research Assistant with the Environmental Quality Commission (EQC). Information used in this report was provided by numerous agencies and individuals. EQC would like to thank those who provided information including KY Division of Forestry - Steve Kull, Larry Lowe, Bernie Anderson, Diane Olszowy, Tim Shehan, Jim Funk. Nature Preserves Commission - Bob McCance, Brainard Palmer-Ball, Joyce Bender, Ronald Cicerello, Marc Evans, Deborah White. KY Dept. of Fish and Wildlife Resources - Lynn Garrison, Jeff Sole, Laura Burford, Ted Crowell, Russ Kennedy, Mark Crammer, John Phillips, George Wright, Rocky Prichert. EQC also would like to thank Joe Dietz and Julie Smither, NREPC; Jeff Hohman, KY Biodiversity Council; Bob Bauer, KY Forest Industry Assn.; Malyn Miller, KY Wood Products Competitiveness Corp.; Gail O'Neill and Rick Lowe, LBL; Kevin Lawrence, Rick Wilcox, Carol Alerich, U.S. Forest Service; Glen Blomquist, Univ. of KY; Jeff Stringer, Matthew Pelkki, Lynn Reiske-Kinney, Univ. of KY, Dept. of Forestry; John Dovak, Jeff Grubs, Scott Hankla, KY Div. of Water; Vickie Carson, Mammoth Cave National Park; Ronnie Decker, Jane Sullivan KY Economic Development Cabinet; Bill Craddock, Natural Resources Conservation Service. EQC would also like to thank those individuals who reviewed and commented on the report including Dr. William Martin, KY Dept. Natural Resources; Mark Matuszewski, KY Div. of Forestry, Lynn Garrison, KY Dept. of Fish and Wildlife Resources; Don Girton, KY Woodland Owners Assn.; Dr. Robert Muller, Jeff Stringer, Univ. of KY, Dept. of Forestry; Bob Bauer, KY Forest Industry Assn.; Ben Worthington, Kevin Lawrence, and Brian Knowles, U.S. Forest Service; Gail O'Neil, Land Between the Lakes; Jeff Hohman, KY Biodiversity Council; Dr. William S. Bryant, Thomas Moore College; Margaret Shea, KY Chapter, The Nature Conservancy; and Gary Mullaney, Westvaco Corp. EQC welcomes comments or corrections to refine and update information in future editions. Any opinions, findings, or conclusions in this publication are those of EQC and do not necessarily reflect the views or policies of the individuals, agencies, or organizations mentioned above. EQC does not discriminate on the basis of race, color, national origin, sex, age, religion, or disability and provides reasonable accommodations upon request.

Printed on recycled paper with state funds. Partial funding was also provided by the State Environmental Goals and Indicator Project, a cooperative agreement between the U.S. EPA and the Florida Center for Public Management to encourage the development and use of environmental indicators.